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Advertisement Index, see page xxviii.

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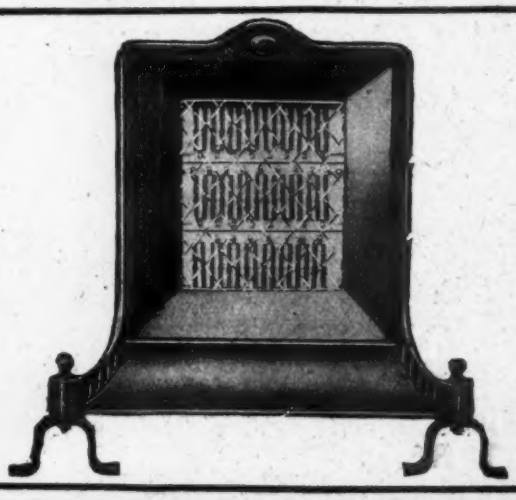

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Vol. LXXXII.] CONTENTS: January 4, 1918. [No. 2,093.

	Page
National Electricity Supply and Reconstruction	1
"Control" After the War	2
Joint Boxes and Terminals for Split Conductor Cables (*illus.*)	3
Reminiscences.—I., by "Ex-Shift Dog"	4
Some Notes on Coal Testing, by G. W. Stubbings (*illus.*) ...	5
National Electricity Supply	6
Illuminating Engineering	8
The Faraday Society	9
War Items	10
Legal	10
Business Notes	11
Notes	14
City Notes	18
Stocks and Shares	19
Market Quotations	20
High-Efficiency Air Pumps for High Vacua, by E. Jones (*illus.*)	21
The Application of Electricity to Various Auxiliaries on Shipboard	22
New Electrical Devices, Fittings and Plant (*illus.*)	23
Correspondence—	
Dust Coal	23
Re Mr. F. L. Rawson	24
Distinctive Colours for Braided Cables	24
New Patents Applied for, 1917	24
Abstracts of Published Specifications	24
Contractors' Column ... ...Advertisement page	xxii

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NATIONAL ELECTRICITY SUPPLY AND RECONSTRUCTION.

IN our issue of December 21st we published, and briefly commented on, a summary of the recommendations of the Coal Conservation Sub-Committee, which we described as of the first importance to the electricity supply industry. That impression is amply confirmed by a perusal of the complete report,* which was issued last week. Indeed, the matter is of such moment that we strongly urge every interested reader to procure a copy and study it for himself; as Lord Haldane remarks in a covering note to the Prime Minister, "it is scarcely possible to exaggerate the national importance of the problem of a technically sound system of electrical supply," and "it is a matter of grave national importance that action should be taken without delay." While the Report is too lengthy for reproduction in our limited space *in extenso*, we are printing elsewhere in this issue a fairly full abstract of its contents, from which it will be seen that the Sub-Committee has treated the subject on the very broadest lines, regarding the problem in the first place from the point of view of an ideal organisation, and afterwards considering the existing situation and the manner in which it should be dealt with in order to bring about an ultimate approximation to that ideal.

To put the matter in a few words, the proposition is to replace the parochial system of innumerable independent electricity supply undertakings by an entirely new organisation of national character and gigantic dimensions, supervised and controlled by a supreme Board of Electricity Commissioners, and sub-divided into some 16 districts, in each of which the generation and primary distribution of electrical energy will be entrusted to a single authority.

One cannot but admire the courage as well as the ability of the Sub-Committee which has created this colossal scheme. It proposes to reverse at one stroke the policy which has held sway for 30 years; to strike off the chains of "municipal boundaries" which, more perhaps than any other factor, have hampered the development of the electrical industry --and therefore almost every manufacturing industry— in this country; to neutralise the handicap of deficiency in water-power by the efficient and economical use of coal, facilitating the establishment of new industries in this country; and by enabling the output of manufactured products to be doubled and trebled, with the aid of electrically-driven machinery, to solve those weighty problems which at present occupy the minds of employers and workmen who look ahead to the after-war conditions. These are all admirable aims. To what extent can they be realised?

That the municipalities will regard the report as constituting a direct attack upon their cherished preserves can hardly be doubted, and it is to be regretted that it has been so phrased as to afford some justification for that inference. Lord Haldane himself, the chairman of the Coal Conservation Sub-Committee, clearly perceives this fact, and by way of anticipation remarks that it should "be kept clearly in mind that whatever conflict there may be between the interests of the local electrical authorities which exist at present and the interests

* "Interim Report on Electric Power Supply in Great Britain." Cd. 8,880. Price 3d. net.

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of a comprehensive scheme, there is no conflict in this matter between the interests of the local community and those of the nation as a whole"; he adds that the Sub-Committee thinks it "should not be further hampered by the mistaken policy of the past," though the necessity of paying fair compensation for existing rights and providing for the liquidation of debt is admitted. We gather from the numerous reports which we have received as to the comments of municipal representatives in the Provinces that they have already taken up an attitude of hostility towards the scheme. As we indicated in our previous remarks on this subject, the Sub-Committee shows a distinct leaning towards private enterprise, to which it attributes initiative and resource, freedom of range, and keenness, qualities "conducive to the fullest measure of success." We also pointed out that in some areas a demand would undoubtedly be set up for some form of municipal control.

The country is therefore faced with the facts that the national interests imperatively require the adoption of some such scheme as that put forward in this report; that the support of the local authorities for the scheme is essential to its accomplishment; and that, according to present indications, that support will be withheld. Is there any way out of this apparent *impasse*?

It is true that under the stress of war conditions, all of us, burgesses and councillors alike, have learnt to subordinate our individual aspirations to the national needs, and to accept the arbitrary decisions of the duly constituted authorities with more or less docility; but little can be done towards carrying the scheme into effect while the war endures, no matter how urgent it may be, and therefore its fruition must be deferred till peace returns. In these circumstances, the powerful influence of the local governing bodies will again assert itself, and no elected Government can over-ride their opposition rough-shod. Hence, to our mind, it is a prime essential to convince them of the absolute necessity of a complete departure from our present policy, as all electrical engineers are already convinced on technical grounds, and no time should be lost in proving to them beyond all doubt that the national interests can be served in no other way, that their local interests will not suffer, and that they will still remain for the most part masters in their own houses. They must part with the functions of generation and primary distribution, but from the sub-station to the consumer they should retain both ownership and control, and to this policy the Sub-Committee offers little objection.

The question of the constitution of the District Electricity Supply Authority, however, will remain to be disposed of, and we foresee that the municipalities, in spite of the satisfactory experience of Tyneside, will never consent to the installation of a private company in this capacity, no matter what safeguards and systems of financial control may be put forward in mitigation of the offence. In short, no organisation that pays dividends under any circumstances need be considered. To meet the views of the municipalities and remove their objections, some form of public control is indispensable. Fortunately we have, in the Hydro-electric Commission of Ontario, a striking example of such a system of control, which has achieved a remarkable degree of success, and has shown that it possesses in large measure those administrative qualities which the Sub-Committee specifies as indispensable. Under the rules of the Commission, the municipalities of Western Ontario enjoy precisely those advantages which it is the object of the Sub-Committee to secure for this country (though the source of energy happens to be water instead of coal), with the result that Toronto, for instance, is *par excellence* an electrical city. This is, we believe, the line of least resistance, as well as the line which conforms most closely to the trend of present-day ideas, which cannot be ignored. Frankly, for our own part, we should prefer a company under statutory control, such as that which was in course of evolution for London, with the concurrence of the L.C.C., when war broke out; but we foresee so many and great obstacles to the adoption of this principle in the Provinces, that we believe it wiser to adopt the second-best plan on the score of expediency.

Here we must leave the subject for the present, but we may direct attention to the views of various authorities summarised in our "Notes" columns to-day, and we hope on a future occasion to comment on some of the technical features of this interesting report.

"Control" After The War.

SIR ALBERT STANLEY, President of the Board of Trade, delivered an instructive speech to the deputation of the Association of Chambers of Commerce the other day. The deputation was interviewing him for the purpose of explaining objections to the Imports and Exports (Temporary Control) Bill. The desire of all traders is for trading operations to be freed from the influence of Government control as speedily as possible after the end of the war. The Board of Trade, according to Sir Albert's reply to the deputation, has devoted very careful consideration to the period of changing over from war control to normal freedom of operation, and its desire is for control to be ended as soon as possible. The official view is that the period need not be a very lengthy one, yet "just as the machine has been gradually wound up, so must it be gradually unwound." Too hurried a transformation might stop the machine altogether. Control will be gradually relaxed, and industry and trade will be able to re-establish their position and eventually go "unfettered." These observations must not be given a wider application than was intended by the speaker. They related to the particular measure that formed the subject of the interview—the resrictions on imports and exports. There may be a sense in which we shall never be able to return to the industrial freedom, however limited we may have thought it to be, of the days before the war, but, so far as import and export trade is concerned, it is interesting to learn from Sir Albert that though the Board has inserted a period of three years in the Bill, it does not contemplate for a single moment that the present restrictions in the aggregate will continue for such a period, and it will use its best endeavours to decide ultimately upon some period which will give general satisfaction. It is obvious to those who are trying to take a broad view of the whole situation as it will emerge when the happy, anxious days of Peace arrive that this subject must be affected to a very large extent by the tonnage position. The demands on all the available tonnage for returning the Forces to this country, to the Colonies, and to the States, for bringing in raw materials and food for ourselves and our Allies, and neutrals, and possibly, according to Peace terms, for starving enemy countries, will form a "first charge." Importation and exportation of raw materials and food form, of course, a large part of the general movement back to the normal state of affairs, but, even when we are not fighting, there will have to be some measure of regard paid to what materials and products are, and what are not, immediately essential for the well-being of the nations interested. There must therefore, be some general plan which will involve Government control for a time to assure that what are really the first things come actually first, and in order that food shortage, unemployment, and chaos may be avoided at what is bound to be a time of extreme crisis.

JOINT BOXES AND TERMINALS FOR SPLIT CONDUCTOR CABLES.

The success of the Merz-Hunter protective system, particularly in the case of E.H.T. electric light and power installations, is undoubtedly resulting in the increased use of three-core split conductor cables of concentric formation for three-phase work, this form apparently being the most popular of the several alternative methods of arranging the split conductors (see fig. 1).

But it has been found that whereas prospective users of this system are generally fully acquainted with the principles upon which it is based, they are not always fully advised as to the best method of jointing and terminating the special cables made use of, and therefore a few remarks upon this subject may be of general interest, especially as improper jointing may render the system ineffective.

To arrange the feeders so that the split conductors of each phase have equal impedance, the cable may be divided into a number of convenient lengths, the inner conductors of one length being connected to the respective outer conductors of the adjacent length.

This arrangement also prevents interference with the equal division of current between the two conductors of each phase by unequal inductive effects due to out-of-balance

Fig. 1.—Section of Three-core Split-conductor Cable.

currents in the feeder itself, and to currents in adjacent feeders or earth.

It will be seen that a special form of joint is called for, but excellent results have been obtained from a joint of simple construction, which has given every satisfaction up to 20,000 volts working pressure, and is made up as follows :—

After stepping back the lead and insulation in the usual way, two short lengths of braided copper of a total section equal to one of the conductors are bound and sweated to each inner conductor ; the two pieces of copper braid are then threaded through apertures provided in the hard-wood separators (fig. 2), the ends of the inner conductors being separated from one another by a diaphragm left solid in the centre of the wood block, and are bound and sweated

Fig. 2.—Hard-wood Separator.

to the outer conductor of the adjacent length. The braid lies loosely along shallow grooves on the outside of the separators, expansion and contraction of the conductors thus being also provided for (fig. 3).

The joint on each phase is then surrounded by a paper tube, the three tubes of the completed joint being bound together, centralised by means of spreaders, fig. 4, and the whole enclosed in a lead sleeve and filled up solid with insulating compound in the usual manner.

Joints made in the manner described by jointers of ordinary experience in E.H.T. work, having no special knowledge of the requirements of split-conductor joints, have withstood 15,000 volts between split conductors for five minutes and 100,000 volts between phases and between phases and earth for 15 minutes, at a temperature of 176° F.

Special apparatus for terminating split-conductor cables has been devised by the majority of firms who specialise in this class of work, but one design only which is known to have given complete satisfaction will be dealt with in this article.

The terminal box in question is the outcome of extensive experiments carried out with the object of discovering the most efficient means of complying with a stringent specification, issued in connection with the protective system under consideration ; it successfully withstood a test of 100,000 volts for 15 minutes between phases and between each phase and earth and 15,000 volts between split conductors for five minutes.

As will be seen from the illustration (fig. 5), the terminal box is provided with a new type of bottle-shaped porcelain

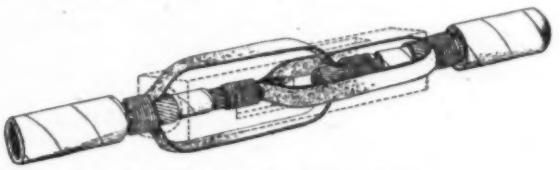

Fig. 3.—Arrangement of Joint.

insulator, which was developed to resist the concentrated stress set up within and around the insulators, owing to the positions they necessarily occupy in relation to the conductors. These porcelain insulators support the special fittings and insulators, Patent No. 106,573/1917 (fig. 6), by means of which the conductors are separated, and which make it possible to reduce the size of the terminal to the dimensions of an ordinary terminal box for three-core, three-phase E.H.T. cable.

The method of jointing, as is apparent from the illustrations, is particularly simple, the apparatus being so designed that after stepping back the lead and insulation in the usual manner, the cores may be cut off two or three inches above the top of the porcelain insulators ; a paper rein-

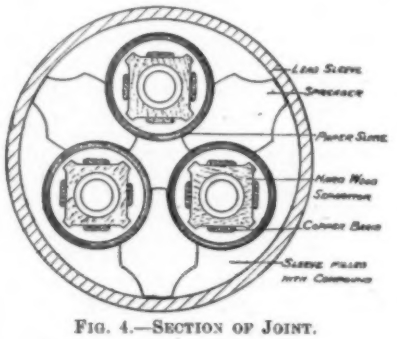

Fig. 4.—Section of Joint.

forcing tube is then placed in the position shown, and taped to each phase. The insulation on each phase is removed in accordance with the illustration (fig. 6), and the looping fittings are connected to the copper tubes, bound and sweated to the outer conductors. The porcelain insulators, being designed to pass over these fittings, are next placed in position, the sockets for the outer conductors being clamped to the tops of the copper tubes, which now form the outer conductors. The tubular portions of the insulators separating the split conductors are then inserted into the copper tubes, and the special screwed jointing ferrules (provided with diaphragms in the centre to prevent moisture creeping down the strand) secured by means of grub screws, and sweated to the inner conductors of each phase, which should be sweated solid. The topmost portion of the smaller insulator is next placed in position, the whole arrangement being finally secured by tightening down the knurled nut provided on the screwed portion of the ferrule terminating the inner conductors. The box is partially filled with compound by means of the

oval cover provided in front of the box, the top of the box and the porcelain insulators being filled with compound by means of a head of compound maintained in a funnel provided for the purpose to a height sufficient to seal the paper insulation on the cores; this height is determined by the height of the funnel and vent pipe, both of which are removed after contraction of the compound has taken place. The space above the compound level forms expansion chambers, which allow for the expansion of the compound filling under working conditions, an air vent being provided in the knurled nut.

It will be noticed that the box itself has solid walls at the top to prevent compound leaking under any circumstances, and to facilitate the fixing of insulators, while the bottom portion of the box is split at the centre line, so that the cable can be arranged in the back half of the box, after the insulation has been removed from the cores without the trouble of threading it through a hole in the casting. The screwed brass wiping gland is arranged so that it can be bolted up between the top and bottom portions of the box after the wiped joint has been made, the gland being secured by means of a special nut provided with earthing lugs; the wire armouring is secured and earthed on to the brass gland by means of malleable iron grips.—J.

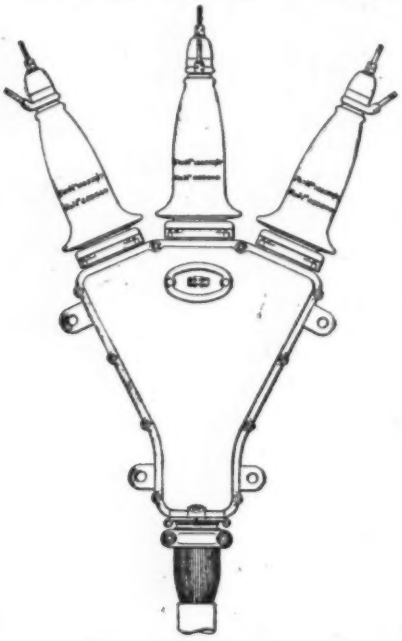

FIG. 5.—TERMINAL BOX.

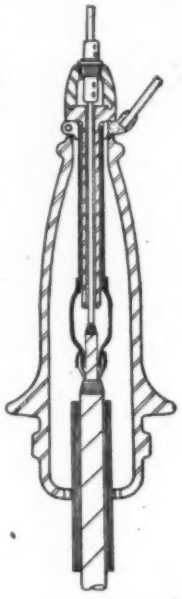

FIG. 6.—SECTION OF SPECIAL TERMINAL.

REMINISCENCES.—I.

BY "EX-SHIFT DOG."

THE monotony of shift work in power houses has been the theme of many a growl at various times, but looking back over some few years so spent, there are many incidents and episodes which are vividly remembered as being exciting and by no means lacking in variety. Priming boilers, machines running away or burning out, intermittent recurring short-circuits, and occurrences of that nature, are certainly not every-day events, but they do happen occasionally, and undoubtedly break the monotony of an otherwise routine but strenuous existence. Many other items of smaller importance also tend to destroy any tendency to vegetate, and it is these affairs from which the most useful lessons can often be learnt.

Episodes of both great and small significance frequently also have their humorous aspects. During the never-to-be-forgotten railway strike of 1912, for instance, a certain power house was guarded against possible attack by regular soldiers of undoubted valour, for inflammatory meetings were expected to be held upon a neighbouring common. Just within the big doors and a little to one side peacefully hummed a 1,000-KW. rotary converter, one of the first of the self-synchronous type put to work in this country; a group of soldiers often lounged about the open door when off duty, while the sentry continued his stolid tramp outside. A heavy short caused the usually good-tempered rotary to flash over badly one day with several thousands of kilowatts capacity behind her. The worthy soldiery, although they doubtless would have faced (and, perhaps, since have done so) the worst of Krupp's "frightfulness" cheerfully, broke and fled, overcome by such unexpected and little-understood noise, smoke, and confusion; and even the sentry took cover behind the wall, probably expecting to see the whole place collapse amid thunder and lightning. Although the writer was exceedingly busy for a quarter of an hour after this occurrence, the spectacle of the khaki-clad figures dashing away in all directions still lingers very plainly in his memory.

Many less noisy episodes take place which are never reported. A night shift at a small A.C. station was run by a reciprocating engine set and a water-tube boiler of very liberal capacity compared with the load carried. The staff consisted of a charge engineer, a driver, and a fireman. The two former became engrossed in the wee sma' hours in an inspection and discussion of some new machinery, and trusted to their hearing that all was well with the plant, until they were startled by the apparition of the fireman running into the engine room and shouting: "Look out for your volts; I've let the fires out!" The driver rushed to his engine, the charge engineer and stoker back to the boiler house. Steam was already back to 100 lb. instead of 150, and the last remaining fire was disappearing over the dumping bars. The pawl drive of the mechanical stoker had slipped and driven the fire forward at a prodigious speed, which had escaped the notice of the fireman until too late. Energy and a supply of oily waste averted a shut down, but the volts were low and the frequency more so, in spite of the cut-off gear being set at its lowest. The steam chart was easily "faked," the volt chart passed without comment, and the fireman—given his chance—developed into an excellent and reliable man.

The prevalency of the practice of "faking" is dying out, it is to be hoped, but still one occasionally meets cases of its deliberate retention. A certain CO_2 recorder would to-day give the same result—a convincingly varying line—if it were supplied with fresh air in lieu of flue gas, and an ingenious cardboard strip, intended to facilitate the reading of a vacuum gauge at a distance, can be so placed that its weight causes the indication of at least 2 in. extra vacuum; but these are exceptions, and, apart from the honesty of the *personnel*, the adoption of stricter supervision and of checking recorders has made faking more difficult than in the past.

It is the usual practice to run the most economical plant the longest possible periods, and in one case the largest unit had also the lowest consumption, even at the light night loads. Consequently this set, a turbo-alternator of 1,500 KW. capacity, frequently ran for several weeks at a time. At the end of a week it was found, however, that the circulating pump and air pump motors, which were D.C., required attention to their brush gear and commutators. It came to be the practice, therefore, to run another turbine, and motor this unit for half-an-hour or so each Sunday morning while having the pumps shut down. At first the Tirrill regulator, normally on the big set, was carefully taken off and transferred to the extra machine, but after a time, someone with the courage of his convictions motored the unit, and allowed the Tirrill to continue its work by means of wattless motoring currents, an arrangement which was perfectly satisfactory in practice. The switchboard was fitted with both ammeters and kilowatt meters, and the latter had a set-up zero, so that it was possible to read directly the reverse power required to drive the turbine (a matter of about 200 KW.) and at the same time to watch the Tirrill regulation upon the fields, and the circulating currents between the machines. The operation of synchronising the second set, motoring the big unit, and, after the pumps had received attention and been restarted, changing back to normal, could thus be done without causing the

slightest departure from the usual straight voltage record which the Tirrill provided. The writer has not heard of any other instance in which a regulator is kept on a motoring machine as a matter of routine; but, of course, it is nothing wonderful theoretically, and may possibly be done elsewhere.

Circulating pump motors are occasionally troublesome, in so much as they are often somewhat inaccessible, usually very reliable, and so do not receive much attention. Vertical shaft motors with centrifugal pumps have sometimes been installed, and are a useful precaution when the engine room or condenser pit is below the level of a neighbouring river or canal. In one case during the erection of some new plant a large and heavy valve was dropped by accident upon cast-iron circulating pipes; the condenser pit was below the level of the canal, and the pump motors were flooded out, causing a complete shut-down. In another case, a circulating pump refused to start in an emergency, and merely blew its fuse repeatedly upon attempting to operate the starter. An investigation showed that a greaser cleaning around it with more zeal than knowledge that same morning had broken the shunt lead between pole windings. Steam-driven condensing plants are neither so economical nor so suitable in other ways for power stations, but in the modernised form they are coming into general favour again on account of their reliability.

In large plants the auxiliaries are nearly always driven at high speed by small and independent turbines, a very compact and simple arrangement, and not so wasteful as might appear, since the exhaust steam is afterwards used either in the main turbine or for heating the feed water. A small steam-driven condenser, dealing with the exhaust from other pumps, fans, &c., had an annoying habit of stopping—a not uncommon failing of that particular type of reciprocating engine—and, moreover, was naturally run almost dead slow when on auxiliaries only. While stopped, the condenser became considerably water-logged, of course, and if not very carefully drained before restarting (and time was precious), used to eject hot water from its relief pipe to a moderate height and thoroughly drench the devoted person of the engineer at its stop-valve. The motor-driven set at this station was a condenser outfit for a 500-KW. turbine, driven by a reputed 30-H.P. motor, single-phase, and of weird design, having commutator and slip-rings, and consuming 17 amperes at 2,000 volts at all loads!

Reverting to electrical matters, one sometimes comes across curious arrangements of gear and occasionally lamentable ignorance among attendants. The writer was once asked by the attendant in sole charge of a 1,000-KW. sub-station near London, containing E.H.T. remote-control gear, rotaries, and a fairly complicated D.C. switchboard, for an explanation of the working of the rotaries' transformers; he was obviously suspected of joking when he mentioned casually that, of course, there was no direct connection between the primary and secondary. "How, then, can the electricity get through to the rotary?" was asked protestingly. Yet that attendant carried out his duties by rule of thumb quite satisfactorily, and, at the time, was earning nearly 50 per cent. more salary than the writer, besides being his senior by quite 15 years. On the same undertaking the E.H.T. bus-bars were of polished copper, and had to be regularly vaselined in order to prevent oxidisation! Further, the fuses for the D.C. bus-bar voltmeters were installed close to the instruments, so that when a selector switch broke down, as one eventually did, there was no check to the short-circuit until the 3/20 cable fused, causing considerable burns to the person operating the switch. Ammeters were also mounted with bare terminals for shunt leads in such a position that the earthed arms of a "Navy-'phone"-type telephone could easily reach them, with disastrous results to the instruments.

In another station a rotary converter was separately excited by a small D.C. generator, belt-driven from it, and the belt was exposed and without guides or strikers; although this was supposed to be a temporary expedient, it remained in use for over 18 months to the writer's knowledge. During that time the belt came off on sundry occasions, and caused considerable variations in the supply, if not actual shut-downs. In yet another station the staff once solemnly filed up the commutator of a high-speed exciter while it was standing!

SOME NOTES ON COAL TESTING.

By G. W. STUBBINGS.

THE large proportion of the total cost per unit represented by fuel in even the most modern and efficient electricity works has now directed attention to the fact that the calorific value of coal is a factor of prime importance in determining the price that should be paid for the same. As coal is really a form of potential energy, the practice of buying coal by weight, although unavoidable, is not, strictly speaking, logical. Thus it is customary to insert a clause in coal contracts requiring a specified minimum calorific value, and not infrequently a sliding scale is adopted, by which the price to be paid depends upon the calorific value. This very necessary procedure has necessitated the systematic testing and analysis of the various consignments of coal as they are delivered, and this testing has frequently to be carried out by those to whom this class of work is none too familiar. The operations of analysing and testing coal really require a more or less thorough training in technical chemical work; but a conscientious man who has had some experience in laboratory work can, after a little practice, obtain very good results.

Directions more or less detailed are to be found in all the standard text-books on technical chemistry. There are, however, several points that may be useful to those undertaking fuel testing in central stations—points which, perhaps, are too familiar to those trained in chemical work to require mention in the text-books, but are not so well known to electrical men.

The complete test of a sample of coal usually comprises an approximate analysis to determine the percentages of moisture, volatile matter, fixed carbon, and ash, and also a direct determination of the calorific value of the fuel by burning a small quantity in a suitable calorimeter. A determination of the percentage of sulphur is sometimes made; but this is not usual, or frequently called for. If it be required, directions are to be found in all the standard text-books, and the process is quite straightforward to those competent to carry out the usual analysis.

A word may first be said regarding the directions for obtaining a legitimate sample of the fuel to be tested. The directions as given in the books seem to the uninitiated to be superfluous and tedious. It cannot, however, be too strongly urged that unless the most careful attention is paid to these directions, all the subsequent work may be quite useless. The chance shovelful taken from the truck that sometimes suffices, is absolutely useless as a sample. The full directions should be carried out if results worthy of the name are required. The method of preparing the sample is also of the highest importance, and the coal must be ground sufficiently to pass through a sieve of the requisite fineness. Great care should be taken that no specks that have failed to pass through the sieve are inadvertently mixed with the final sample.

For the determination of moisture a weighed sample, from 1 to 2 grammes, is dried at a temperature of 110° C. for half-an-hour. The sample is then cooled in a desiccator and weighed. The drying is continued for a further quarter-of-an-hour, and the sample is then weighed again. This is repeated till the weight does not further diminish; it may rise slightly owing to oxidisation, but in this case the lowest weight is taken as the correct one. It is important that the drying temperature be not above that given; at a temperature even moderately higher, decomposition takes place, and some volatile constituents are given off. No attempt, therefore, should be made to hasten the process by raising the temperature. It is, moreover, absolutely necessary to cool the sample in a desiccator. The desiccating agent necessary is concentrated sulphuric acid, which acid should be renewed at regular intervals, and before it shows signs of discoloration. It should be borne in mind that the sample of coal, after drying, is in a condition rapidly to absorb moisture from the atmosphere, and that, unless a desiccator be used, the result will be of little value.

A determination of surface moisture should be made if the sample, as taken from the trucks, has been surface dried before preparation. This test is made by exposing a

weighed sample of the coal, as taken from the trucks, to a temperature of 70° F. for 24 hours. A correction for this surface moisture will have to be made to the final analysis.

The determination of the volatile constituents and of the ash is fairly straightforward. In testing for ash the process of ignition is sometimes hastened by occasionally allowing the crucible to cool, thereby allowing air to be drawn into the interstices of the heated mass. It is also possible, with care, so to arrange the position of the crucible as to obtain a slight movement of air across the coal, the combustion being thereby hastened. This draught must, however, be very slight, or some of the ash will be blown out of the crucible. The weighing and re-heating in the ash test must be repeated till a constant weight is obtained. The appearance of the sample is no guide as to the degree of completion of the ignition, the only sure sign being constancy of weight after 10 minutes' re-ignition. Cooling must take place in the desiccator, as the highly porous ash will absorb moisture with avidity.

The direct determination of the calorific value of the fuel is carried out by burning a weighed quantity in a calorimeter, and observing the rise of temperature of a known quantity of water. In some calorimeters the oxygen necessary is passed directly into the combustion chamber; in another system the oxygen is supplied by intimately mixing with the coal a definite quantity of sodium peroxide. Owing to the heat of the subsidiary chemical actions taking place with this method, the actual weight of coal used is less

Fig 2

Fig 1

FIGS. 1 AND 2.—HEATING AND COOLING CURVES.

than the nominal, in order that this extraneous heat may be compensated for. In view of the complexity of the chemical action between the coal and the sodium peroxide, and its possible variation with the class of fuel being tested, it would seem that this method is not one yielding results of the highest accuracy. It possesses, however, the important advantages of simplicity of working and cheapness of equipment, and while the results are not, perhaps, quite so good as those obtained with a more expensive apparatus, they are, nevertheless, very useful when obtained by a careful observer.

As the range of the temperature of the water in the calorimeter is small, not usually much over 10° C., it follows that the initial and final temperatures must be observed with great care if accurate results are desired. The water in the calorimeter must be stirred till the reading of the thermometer is constant, before the combustion is started. After the combustion of the coal the water must be constantly stirred, and the reading of the thermometer carefully observed till it begins to fall. Until the fall of temperature commences there is no certainty that the whole heat of combustion has been communicated to the calorimeter and its contents. As some considerable time is taken for the final temperature to be reached, it follows that, as the calorimeter is during this time above the temperature of the surrounding air, it is constantly losing heat.

This loss of heat can be greatly reduced by standing the calorimeter on some non-conducting substance, and by having its exterior brightly polished. A correction for loss of heat by radiation can, however, be made with considerable exactness, and if results of a high degree of accuracy be aimed at, this correction may well be applied. The procedure is as follows: From the moment the combustion is complete, readings of the thermometer are taken at regular intervals of, say, 20 seconds, till the temperature begins to fall. Two readings are now taken at an interval of two or three minutes, and from these readings the rate of fall of temperature in degrees per 20 seconds can be obtained for the temperatures intermediate between these two readings. According to Newton's law of cooling, this rate of fall of temperature is proportional to the excess temperature of the calorimeter over that of the surrounding air. A curve of rate of fall of temperature can now be constructed, as fig. 2, the temperature t', at which the cooling is zero, being, of course, that of the surrounding air, and the curve being a straight line between a point corresponding to these conditions, and another point corresponding to the observed rate of cooling at the maximum temperature. The original time and temperature readings are now plotted, and a curve is obtained similar to fig. 1. The average temperature during each 20 seconds' interval being obtained, the fall of temperature during this period is obtained from fig. 2, and this loss of temperature is added to the temperature ordinate corresponding to the termination of this interval. Thus, the fall of temperature corresponding to the temperature at a time A being found, this amount is added to the ordinate Bt to give a new ordinate Bt'. By repeating this for each 20-sec. interval a new curve is obtained with a flat top, the flat portion corresponding to the constant temperature that would have been attained had there been no cooling, and giving the corrected final temperature.

It should be remembered that throughout the whole of the analysis and test of the fuel, patience and methodical procedure are most likely to obtain accurate results. Chemical work is very different from electrical, and the speed with which electrical measurements can be observed offers a great contrast to the comparatively lengthy process of even an elementary chemical examination. Bearing this in mind, and conscientiously following the directions given in the standard text-books, the ordinarily well-trained electrical man should obtain results good enough to enable the purchasing of coal to be managed on a rational and scientific basis.

NATIONAL ELECTRICITY SUPPLY.

INTERIM REPORT OF THE COAL CONSERVATION SUB-COMMITTEE.

IN our issue of December 21st we published a summary of the interim report of the Coal Conservation Sub-Committee of the Reconstruction Committee on Electric Power Supply in Great Britain, which was prepared by a sub-committee appointed to deal with Power Generation and Transmission.

The complete report which has now reached us is exceedingly interesting, and we think that very few of those who have studied the problem of electricity supply in this country will be disposed to disagree with the broad principles enunciated therein.

The following extracts will be of interest:—

Summary.—The coal consumption involved in the production of motive power in the United Kingdom amounts at the present time to 80,000,000 tons per annum, equivalent in value to, say, £40,000,000 at pit head.

In the industrial reorganisation which must take place on the termination of the war the further development of power is of great importance. The present use of motive power per employé is only about half that in the United States of America.

It is only by largely increasing the amount of power used in industry (by two or more times) that the average output per head (and as a consequence the wages of the individual) can be increased. Power may be most efficiently applied to industry by the medium of electricity.

Technically and economically the electrical energy can be best provided by a comprehensive system, as may be amply proved from experience gained in those parts of the world where such systems are in existence, notably in Chicago (Illinois), on the North-East Coast of England, on the Rand, and in certain industrial districts of Germany. Power production in large super-plants, with generating machines of 50,000 H.P. or more, will not only be far more economical than in a large number of smaller plants, but will ultimately involve great economies of capital by securing a better load and a more effective use of the plant. Such super-plants, if suitably situated on large sites, would make in possible—so far as it was economical to do so—to extract the by-products in the shape of oils, motor spirit, &c., from the coal before using it as fuel, thus avoiding to a large extent the necessity of importing them.

The super-plants would feed into the main trunk distribution system, which must be laid down throughout the country. For this purpose the country should be divided into some 16 districts, throughout each of which there should be a standard periodicity and trunk main voltage.

This main trunk distribution system would collect any waste power available wherever situated, and deliver it where it could be profitably used. It would also, by saving the cost of transport, make it commercially possible to bring much coal to the surface, which is at present wasted and left in the pit, and which under the new conditions would be turned into electrical energy at or near the pit head.

The saving in coal throughout the country would, in the near future, amount to 55,000,000 tons per annum on the present output of manufactured products.

If the coal so saved were used for the production of further power it would be possible to generate continuously not less than 15,000,000 H.P., which would more than compensate for the absence of large water powers in this country, and admit of the manufacture here of many products which are at present only made in America and on the Continent.

The present system of electrical power distribution throughout the country, which is undertaken by over 600 authorities in as many separate districts, is technically wrong and commercially uneconomical. The present average size of generating station is only 5,000 H.P., or about one-fourth of what should now be the smallest generating machine in the power station. The "Power Act" legislation inaugurated some 15 years ago has not had the desired result on account of the restrictions imposed upon the power companies.

A national system of electric power supply would greatly facilitate the electrification of railways with its attendant advantages, save large sums of money at present spent on the transport and distribution of coal, and bring within reach of the community as a whole the great benefits of an increase in the use of electricity for domestic purposes, advantages which, taken together, are perhaps of more value than the direct coal saving.

It is estimated that to-day the production of power, including railways, absorbs at least 80,000,000 tons of coal.

The average coal consumption per horse-power hour throughout the country has been halved during the last 25 years. In spite of this, the total amount used has increased. A consideration of the probable future development of British industries shows that it is *not so much by reducing our total coal consumption as by increasing our industrial output for a given coal consumption that progress will be made.* Unless this result is attained we shall be faced with the necessity of doubling our coal output or reducing our coal exports to nothing. *But the present coal consumption would, if used economically, produce at least three times the present amount of power.*

It is obvious that improvement in the commercial prosperity of a country—that is to say, the average purchasing power of the individual—depends on increasing the output per head.

Now it is possible to increase the output per head by harder work on the part of each individual, but there is far greater promise in increasing his output by giving him more machinery to multiply the effectiveness of his efforts.

The following table from the Census of Production shows the extent to which output is dependent upon the use of power:—

Average net output, per head.	Males, per cent. of all employed.	Females, per cent. of all employed.	H.P. of engines at factories, per 100 employed. In all establishments.	In factories.
Under £50	31·9	68·1	21	92
£50 and under £75	40·0	60·0	50	67
£75 ,, £100	72·4	27·6	97	118
£100 ,, £125	90·2	9·8	100	189
£125 ,, £150	98·0	2·0	266	269
£150 ,, £175	64·0	36·0	81*	89*
£175 ,, £200	92·0	8·0	215	221

* The small amount of power used per hand employed is explained by the fact that this group includes trades such as the tobacco industry, where a large proportion of female labour is employed.

In the United States the amount of power used per worker is 56 per cent. more than in the United Kingdom—if we eliminate workers in trades where the use of power is limited, or even impossible, we shall probably find that in the U.S.A. the use of power, where it *can* be used, is nearly double what it is here. The best cure for low wages is more motive power. Or, from the manufacturer's point of view, the only offset against the increasing cost of labour is the more extensive use of motive power. Thus the solution of the workman's problem, and also that of his employer, is the same, viz., the greatest possible use of power. Hence, the growing importance of having available an adequate and cheap supply of power produced with the greatest economy of fuel.*

One question which has been settled conclusively during the past 15 years is that the most economical means of applying power to industry is the electric motor. In the factories put down for the production of munitions during the war, 95 per cent. of the machinery is driven by means of electricity, and it is only a question of time for all power to be applied in this way. Thus, the problem is not so much how to apply the power to the tool or process, as the case may be, but how best to generate the electric power.

Broadly speaking, there are two alternative methods, namely, what may be termed the *individualistic method* and the *collective method*. In the first case, each manufacturer generates his own electric power, generally in a power station situated in his works; in the second the power requirements of a large number of individuals, in fact, of the community, are pooled and dealt with collectively.

In the case of the individual method the plants are small, occupied for a small portion of the day only; as a consequence, the capital cost is of undue importance as compared with the cost of coal, with the result that cheaper and less economical plant is used since it pays to save money in capital and spend it on coal.

In the case of the collective method, the economy of carrying out electrical transmission on a large scale enables the plant to be placed on a site offering the best water and transport facilities—conditions essential to economy. The pooling of loads admits of the use of large electrical generating machines, which is also essential to economy, and the load is of such a nature that the number of generating machines in operation can be regulated to suit the requirements of the load throughout the day. Due to the absence of coincidence of the requirements of the various factories supplied, the amount of energy produced per horse-power of plant installed is much greater. As a consequence, the cost of coal is the predominating factor in the total cost, and installation of the most economical plant is justified. The natural tendency in the case of the collective method is, therefore, to concentrate on coal economy; on the contrary, the tendency in the case of the individualistic method is to economise in capital and waste coal, especially in a country like England, where coal is relatively cheap.

Now it is certain that arrangements ought to be made in the near future for the manufacture in the United Kingdom of many products necessary for the development of the industrial community, which are not now made here, and which require large amounts of electric power at very low cost. In any case, after the war plants will have to be erected for generating power cheaply in order to deal with these processes, and it is submitted that the opportunity should be taken for combining those plants with the plants necessary for the supply of the general power requirements of the country. This would reduce the cost of electric power to a minimum for both purposes, and, what is perhaps more important, free a large amount of the coal output for use in the generation of electricity for these special processes. The two must be done together. There should be no delay in the erection of such plants, but the sites should be chosen so as to admit of the "super-power stations" which it will be necessary to erect being also suitable for working in with a power system for the whole country.

If the manufacturer can obtain a reliable supply of power as cheaply, or more cheaply, from an outside source than by putting up plant himself, he is able to save his capital for use in his own particular trade. Moreover, power can be delivered to the individual manufacturer with greater economy in the use of coal from a collective system than from a series of individual plants, for the economical generation of electricity implies the use of large prime movers, and the economical size of generating machine is substantially larger than the requirements of any one of the largest factories.

It is broadly true to say that, as regards the country as a whole, the requirements of each municipal area, each railway, and each factory are dealt with separately, with the result that the average size of generating machine employed is certainly not more than a tenth—and probably not more than a twentieth—of what it ought to be. Under such conditions, economy in coal consumption is impossible.

A conspicuous example of the necessity of the multiplication of individual power plants, which has arisen from the fact that no large central supply was available, is afforded by the recent addition to the power stations of London of eight railway power stations, of an average capacity of 24,350 KW., within a distance of four or five miles from Hammersmith, in addition to 21 other power stations already existing.

With the exception of Lots Road, all these additional stations are badly situated as regards water facilities, and they might all have been advantageously combined on one site with great economy of capital, labour, and coal.

The position of large local authority undertakings in the Midlands is most unsatisfactory. Their power station sites have been primarily selected from the point of view of retaining the works within the city areas, so that the "rates" on

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* Unless cheap power is available the tendency must be to develop those industries where the output per head is small rather than those, such as, for instance, electrochemical products, where the output per head is large—industries which are daily becoming of increasing national importance.

such works may be retained by the operating local authority. None of the undertakings of Birmingham, Liverpool, Manchester, or Sheffield have sites with proper water and condensing facilities. The whole of these undertakings use cooling towers. These undertakings generated during the last 12 months between 600 and 700 million units. While the present position is most unsatisfactory, the future expansion of these undertakings gives rise to still greater apprehension. Important extensions on new sites are already projected, the additional plant proposed aggregating some 300,000 KW. to 400,000 KW. In the case of Birmingham, the new site chosen is within the city boundary, and the condensing facilities are limited to cooling towers, and owing to shortage of water supply raw sewage effluent will have to be used for "make-up" purposes. In the case of Sheffield, the new site, which is the subject of a Parliamentary inquiry, adjoins the city boundary, and cooling towers for dealing with a 50,000-KW. demand will have to be used during long periods of the year.

If power* is to be supplied throughout the country at the lowest possible price, the following conditions must be secured:—

1. The power users in each industrial district must be supplied from one common inter-connected electrical power distribution system.

2. Large generating machines, not less than 20,000 H.P., must be used, and they must be erected in the best possible positions for economical production. In the more important industrial districts generating machines of 50,000 H.P. might be advantageously used.

3. Power available from surplus gas or waste heat should be turned into electrical energy on the spot in local plants which would feed into the main distribution system. N.B.—As regards waste coal—*i.e.*, coal which it does not at present pay to bring to the surface—this could, where transport was the ruling consideration, also be used on the spot.

To-day, if a colliery owner has small and poor coal in his colliery which it does not pay him to bring up because it cannot stand the freight, or a coal of high calorific value, but too friable to stand transport, he cannot under existing conditions contemplate turning it into electricity at the pit's mouth—extracting the by-products in doing so—because, except in certain areas where a trunk main system exists, there is no market for the electricity, there being no means of transmitting or distributing it.

There are important additional advantages to be secured from the erection of plants on roomy and efficient sites rather than on crowded and inefficient sites, apart altogether from those resulting from the increase in the size of the plant.

Apart from the saving in fuel, centralised power production is essential if the capital charges and labour costs are to be reduced to a minimum.

At the present time the supply of electricity in Great Britain is dealt with by some 600 undertakings. The average generating plant capacity of those undertakings which have power stations is 5,000 H.P., or about one-fourth of the capacity of one single generating machine of economical size, and about one-thirtieth of the size of what may be considered as an economical "power station unit." The following table gives some particulars of electricity supply in London:—

LONDON ELECTRICITY SUPPLY.—POSITION IN 1913.*

	Central area.	Greater London.
No. of authorities	39	70
No. of generating stations†	41	70
Average size of stations	7,646 KW.	5,285 KW.
Average size of units	787 KW.	632 KW.
No. of types or systems of generation	31	49
No. of frequencies	8	10
No. of voltages { generation	20	32
No. of voltages { distribution ...	21	24
No. of methods of charging and prices	50	70

* Slight changes have taken place since 1913, when the above table was prepared for the L.C.C., but it has not been considered necessary to revise the table since the general situation remains unaltered.

† In addition, there are nine traction stations within the Greater London area, eight of which are within the Central Area.

It is not suggested that a scheme of power distribution for the whole country can be treated as an ordinary engineering project and commenced *de novo*, but it is urged that the time has now arrived for the matter to be considered comprehensively, and for the reorganisation of the existing indiscriminate power supply systems to be undertaken on correct lines. The main transmission system must be alternating current, three-phase, at a high voltage—no engineer would dispute it—but a more difficult question is that of frequency: in Great Britain no less than 10 frequencies are employed to-day.

A division of England and Scotland into areas having frequencies of 50, 40, and 25 cycles respectively represents the least amount of scrapping of existing plant consistent with development on right lines. Roughly speaking, England, south of a line between the Humber and Carlisle, could be run at 50 cycles, with the exception possibly of the Black Country; between this line and the Cheviots might remain at 40 cycles, whilst the whole of Scotland could be standardised at 25 cycles. The chief difficulties are, however, not technical ones, but what may be called political.

In order to illustrate the inefficiency of the present system, a list of the average prices received in the Lancashire industrial district is given in the following table, and compared with the average price paid by consumers on the North-East Coast.

AVERAGE PRICES CHARGED TO CONSUMERS BY ELECTRICITY UNDERTAKINGS IN THE LANCASHIRE AREA.

	Private supply. Pence per unit.	Public lighting. Pence per unit.	Traction supply. Pence per unit.	Total supply. Pence per unit.
Liverpool Corporation ...	1·82	1·88	1·13	1·50
Manchester Corporation ...	1·02	2·11	1·03	1·02
Eccles Corporation ...	2·17	2·18	1·13	1·71
Salford Corporation ...	1·31	1·35	1·27	1·29
Stretford Corporation ...	2·27	1·14	1·13	1·49
Stockport Corporation ...	·90	·50	·55†	·80
Bolton Corporation ...	1·03	—	1·10	1·05
Bury Corporation	·67	2·24	1·08	·72
Heywood Corporation ...	1·30	3·00	1·25	1·29
Leigh Corporation ...	1·65	—	—	1·65
Rochdale Corporation ...	1·33	—	1·01	1·20
Wigan Corporation ...	1·50	2·26	1·19	1·38
Ashton Corporation ...	·72	1·37	1·22	·85
Oldham Corporation ...	1·42	1·99	1·50	1·44
Stalybridge Joint Board ...	·67	1·10	·50	·66
Accrington Corporation ...	1·12	2·59	1·75	1·15
Blackburn Corporation ...	1·63	1·95	1·39	1·58
Burnley Corporation ...	2·00	1·11	1·18	1·49
Colne Corporation... ...	2·25	1·00	1·63	2·00
Darwen Corporation ...	1·22	3·17	1·27	1·29
Nelson Corporation ...	2·68	—	2·00	2·42
Rawtenstall Corporation...	1·16	2·69	1·23	1·03
Middleton Corporation ...	1·31	4·35	1·32	1·32

† Does not include any capital charges.

The figures as to the cost of electrical energy throughout this important industrial area may be compared with those for the North-East Coast district of England, where the entire area, somewhat larger in actual square mileage, and much smaller in population and in power requirements and, therefore, less advantageous from a supply point of view, is served by a group of power companies from one inter-connected electrical distribution system. The average price paid for electrical energy is less than ½d. per unit, and the use of electric power per head relative to the population is three times as great.

(To be concluded.)

ILLUMINATING ENGINEERING.

BY A. P. TROTTER.

(Extracts from Presidential Address to the ILLUMINATING ENGINEERING SOCIETY.)

WHEN our members are called upon to advise on the lighting of some place or building, or to carry it out, they examine the conditions and consider the requirements; they recommend the most advantageous method, and calculate the appropriate arrangement of lamps. If the job is one of some importance, a specification is drawn by a consulting engineer, tenders are invited, the best one is selected, a contract is made, and the work is carried out by a contractor. The results are checked by a photometer, and the client is told that the job is finished. Then he comes and judges whether the lighting is "good or bad" merely by using his eyes! This is one of the difficulties of our branch of engineering, and its warns us not to rely too much on rules and formulæ, and that we must interpret the readings of the photometers with discretion. The instrument may make a definite statement, but we must consider the context.

The eye only is the judge. Even if an instrument should one day be invented which would indicate a quantity of light on a scale like a thermometer, our client's opinion of the lighting will not be materially influenced. Illuminating engineers must therefore give some attention to the subjective and to physiological interpretations of sense-impressions.

The National Illumination Committee of Great Britain is a body affiliated to the International Commission on Illumination. It was constituted in 1914 by the co-operation of our Society with the Institution of Electrical Engineers, the Institution of Gas Engineers, and of the National Physical Laboratory, to carry on and to develop the work which had been begun by the original International Photometric Commission.

The Committee has given preliminary consideration to a uniform international method of rating and marking all sources of light, and to the nomenclature of photometric terms. It invited a number of laboratories and private individuals to investigate the relation between the height of the

* The use of electricity for motive power purposes has been specially emphasised, but electrical smelting and electrochemical processes are becoming increasingly important. They have, however, only been developed to a small extent in this country up to now, due to the fact that it has not been possible to obtain electrical energy at a low enough price. The electric refining of steel, among other matters, is known to be urgent. In addition, there are the various domestic uses of electricity, such as heating, cooking, and power, which are capable of rapid development.

flame of a Hefner amylacetate lamp and its luminous intensity, with the object of settling the height at which it would give a light equal to one international standard candle, that is to say, to 1.111 times the light of the usual 40 mm. flame. Five reports were received, and these, together with an American paper and Liebenthal's original work, gave a mean result of 44.2 mm. for the height of the flame. Excluding two for special reasons, the remaining five are within the range of half a millimetre, or about two per cent. of light. While this is a satisfactory performance for a lamp introduced so long ago as 1884, it is not sufficient for scientific work of precision.

It is not possible at the present time to discuss freely the desirability of darkening the streets of towns during war time as a protection against air raids, or the degree or mode of darkening if this is considered advisable.

The original anti-air defences of London were hurriedly thrust upon the Admiralty, and there was no time to go into new and difficult questions, and, of course, there was no experience to give warning of the accidents which did in fact result from over-darkening. The need for some modification soon became apparent. In November, 1916, I was sent for, and was asked to consider certain points which were put before me, and, with an officer of the London district, I inspected various parts of London in which the lamps had been obscured in various ways. In one street I measured an illumination considerably less than one-ten-thousandth of a foot-candle. I was asked to consider how much light could be allowed without revealing the topography of the district. In order to study the question more carefully, I was invited to make an aerial reconnaissance from a balloon at night.

A stiff east wind was blowing, and threatened to carry the two balloons which ascended to the west. They were therefore so ballasted that we shot up at once to 3,500 ft., where we found ourselves in the calm which sometimes lies between an east wind and a higher reverse current. There was plenty of time to study the lighting over a district of some five or six miles in diameter. The night was clear, cloudless, and moonless. The most striking feature was the unmistakeable contrast between the black river and parks and the dim shimmer of the gloomy houses. Innumerable windows with drawn blinds gave the appearance of a granular film of brightness nearly equal to that which would have been produced by an illumination of 0.1 foot-candle. At that date, the streets were easily traceable by the patches of light below the screened lamps. The sight was very beautiful, and it is sufficient to say that the authorities are of opinion that it is impossible to hide such a city as London by reducing the street-lighting. On the other hand, this does not apply to small towns, for, during a run of 40 miles into the country, after the waning moon had risen, at the trailing height of 350 ft., it was impossible to distinguish between houses and haystacks. A small town and several villages were crossed without being seen. I can confidently assert that it is possible to obliterate a small town by extinguishing all street lamps and by careful shuttering and screening of the windows. But this screening must be intelligently carried out.

In the warfare of the future we must expect surprise attacks by large air squadrons. It will be necessary for engineers to consider the best means for control of street lighting, and, indeed, of all outdoor lighting, from the source, and provision for immediate extinction, when called upon by the military authorities to take this step. An independent street lighting system affords an excellent method of giving warning of an air-raid at night. There are very few instances of separate mains for street lighting, but a relay system for the control of electric lamps has been successfully tried, and seems to be applicable for this purpose. It must be remembered that our coast towns, and indeed those near the coast, are visible from a considerable distance at night in peace time. Enemy aircraft, deprived of the guiding lights of towns, have often hopelessly lost their way, and have scattered their bombs on open fields. Complete darkening of the whole country is undesirable for many reasons, even if it were possible, but a carefully considered reduction of lighting is in many cases well worth much inconvenience and some risk of accidents.

THE FARADAY SOCIETY.

AT the December meeting of the Society a miscellaneous collection of papers was discussed, concerned mostly with problems of applied physical chemistry. The most important to the engineer was that contributed by Mr. ALEXANDER L. FEILD, United States Bureau of Mines, on "The Viscosity of Blast-furnace Slag and its Relation to Iron Metallurgy."

The paper records a brilliant experimental research undertaken by Mr. Feild; the construction of an apparatus in which the viscosity of molten slag can be measured at furnace temperatures, namely, up to some 1,600 deg. C. The method is an adaptation of that of Margules used for the viscosity of liquids. In the form adopted by Mr. Feild, it consisted essentially of two concentric cylinders of Acheson graphite, of which the outer one, containing the molten slag, was rotated at one revolution per second, when the torque exerted on the inner one, really a graphite rod hanging on a steel suspension ribbon, was a measure of the viscosity of the fluid between them. A mirror on the suspension system recorded with great accuracy the amount of twist, and hence the viscosity, once the law of the apparatus was known and it had been calibrated against a viscous fluid, such as castor oil, of known viscosity. To maintain the slag and the viscosimeter at high temperatures the apparatus was contained in an electric furnace of the granular carbon resistance type, the heating zone being 3 in. in diameter and 6 in. long, and the outer furnace shell 14 in. in diameter and 18 in. long. The large size of the latter allowed of high heat insulation. The resister material was held in the zone between two concentric alundum tubes, surrounded by magnesite chips, and outside of all kieselguhr for insulation. Graphite ring electrodes brought the current into the heating zone from a transformer giving voltages ranging from 40 to 100, the maximum current being 110 amperes. The atmosphere of the furnace, like that of the hearth of a blast furnace, was a mixture of carbon monoxide and nitrogen. The temperature of the slag was measured by means of an optical pyrometer of the Holborn-Kurlbaum type, sighted directly upon the surface of the rotating slag.

Measurements were made with eight types of commercial slags, and also some synthetic slags, at a temperature of 1,500 deg. C., and the viscosities varied from 230 to 480 (H_2O at 20 deg. C. = 1). The relation between viscosity and temperature was also studied, the curves connecting them being found to approximate to rectangular hyperbolas. The high viscosity of slag can probably be chiefly attributed to its silica content; anyhow, a very high silica content is certainly accompanied by high viscosity. Examination of quartz crystals by Bragg's method of X-ray analysis points to an unusually complex structure, three silica molecules being associated with each point of the space-lattice. This polymerisation tendency must be the fundamental cause of the extreme viscosity of silica and of the high viscosity of silicate combinations.

The practical applications of these measurements and their further consideration are obvious. The fuel economy of a blast furnace is to a great extent dependent upon the fluidity of the slag, for this must attain a certain value before the FeS can diffuse from the iron into the slag, and the CaS formed diffuse away with sufficient rapidity to prevent the reverse reaction, that is to say, before desulphurisation can take place and iron be produced. A slag requires a minimum temperature of 1,400 deg. C. to attain a working fluidity; no iron will be produced in the furnace unless the temperature distribution is such that it can acquire this temperature.

The work so far recorded by Mr. Feild is merely an indication of the importance of the subject, and its bearings on metallurgy. The wider aspects of the problem of slag viscosity and its effect upon desulphurisation are now engaging the attention of the Bureau of Mines, and further reports will be awaited by metallurgists with considerable interest.

The Concentration of Sulphuric Acid.—An interesting application of physical principles to further industrial efficiency was described by Prof. ALFRED W. PORTER, F.R.S., in a paper on "The Thermal Properties of Sulphuric Acid and Oleum."

The existing data on heats of solution and dilution, and evaporation of these acids apply only to atmospheric temperatures. War requirements have necessitated their being concentrated at high temperatures in enormous quantities, and the question of small improvements in efficiency has become of financial importance. Prof. Porter has ingeniously extended existing data to temperatures of 200 deg. C. and over by indirect methods, either from vapour pressure by means of Clapeyron's formula or from thermal capacities. The values obtained are tabulated and represented on charts in such a way as to be readily available for factory practice.

The other papers presented were chiefly of chemical interest.

The next meeting of the Society will take place on January 14th, 1918, and will be devoted to a general discussion on "The Setting of Cements and Plasters."

ANNUAL GENERAL MEETING.

The annual general meeting was held on December 12th. The resignation of the Treasurer, Dr. F. Mollwo Perkin, who had acted in that capacity since the formation of the Society in 1903, was received with much regret. Mr. Robert Mond, F.R.S.E., was elected as his successor The following officers and members of Council were also elected:—

President: Sir Robert Hadfield, Bart., F.R.S.

Vice-Presidents: W. R. Bousfield, K.C., F.R.S., Prof. F. G. Donnan, F.R.S., Dr. Eugene Haanel, Prof. A. K. Huntington, Dr. T. Martin Lowry, F.R.S.

Council: W. R. Cooper, Dr. C. H. Desch, Dr. J. A. Harker, F.R.S., Emil Hatschek, Cosmo Johns, Prof. Alfred W. Porter, F.R.S., E. H. Rayner, A. Gordon Salamon, Dr. George Senter, Cav. Magg. E. Stassano.

The report of the Council stated that in spite of adverse conditions the past year had perhaps been one of the most fruitful in the history of the Society, whether measured by the interest of the meetings held, the value of the work published, or its activities in the wider field of scientific and technical progress.

Early in the year the Society presented a memorandum to the Ministry of Munitions on the production of synthetic nitrogen compounds, and as an outcome of a conference which took place between representatives of the Society and of the Munitions Inventions Department of the Ministry, a Nitrogen Products Committee of the Department was formed.

The Society has presented to the Department a series of sectional reports on many of the aspects of the problem under

consideration, drawn up by Messrs. W. R. Bousfield, W. R. Cooper, E. Griffiths, F. M. Perkin, and F. S. Spiers, and it has also initiated some experimental work.

The Society is conducting a research on "The Setting and Disintegration of Salts and other Crystalline Substances," for which it has received a grant from the Department of Scientific and Industrial Research.

General discussions held in the course of the year included one on "Methods of Obtaining High Temperatures in the Laboratory," and another on "Refractory Materials," which proved to be a function of outstanding importance, attracting widespread interest.

In conjunction with other Societies, the Faraday Society was instrumental in calling together a conference to discuss means for carrying into effect a scheme of co-ordination between the various bodies interested in refractories research and standardisation. Later in the year a second conference was held, which resulted in the appointment of a Provisional Organising Committee to draft a scheme for a proposed Association for Refractories Research for the consideration of the industries concerned.

WAR ITEMS.

Light and Power: A War Regulation.—The following is a new Regulation which has been published under the Defence of the Realm Act:—

11A. The Minister of Munitions, with a view to maintaining or increasing the supply of light, heat or power for the purpose of the production, repair or transport of war material, or any other work necessary for the successful prosecution of the war, may by order direct that lights of any specified class or description shall be extinguished or their use restricted to such extent, between such hours, within such area, on such premises, and during such period as may be specified in the order, and if any person having control of any light, or occupying, or having control of, or managing, or being in charge of premises in, on, or in connection with which any light is used acts in contravention of any such order he shall be guilty of a summary offence against these regulations:

Provided that this regulation shall not apply to any light required to be kept lighted by a competent naval or military authority, or other officer authorised by him for the purpose, or under any order made under Regulation 11 by the Secretary of State, or the Secretary for Scotland.

Tramways in War-time.—The following new Regulation has been issued under the Defence of the Realm Act:—

After Regulation 7BB the following regulation shall be inserted:—

7BBB. (1) The Board of Trade, for the purpose of making the most efficient use of the materials or plant belonging to a tramway or light railway undertaking with a view to the successful prosecution of the war, may by order require the whole or any part of the rolling-stock, materials and plant, including permanent way, of any such undertaking to be placed at their disposal or at the disposal of any person or body of persons named by them.

Where any such order has been made the Board or any such person or body of persons may take possession of such portions of the rolling-stock, materials or plant of such undertaking as they may require, and may remove them and make use of them for the purposes of any other tramway or light railway.

(2) Any order made under this regulation may be revoked, extended or varied as occasion requires.

(3) If any person fails to comply with the provisions of any order made under this regulation or wilfully hinders or impedes the execution of any such order he shall be guilty of a summary offence against these regulations.

Electrical Restrictions at Rome.—A new set of regulations controlling the use of electricity for lighting and heating has just been issued by the municipal authorities at Rome. Exits of theatres, concert halls, &c., will only be allowed one lamp, not exceeding 60 watts. The present lighting of shop windows and show cases is to be reduced by 50 per cent., by discontinuing half of the lamps at present in use, and keeping the candle-power of the remaining half at the present value. No further extensions will be permitted, either by changing the C.P. of the lamps or otherwise, in the heating and lighting installations of shops, offices, public buildings, &c. The use of current for heating is forbidden between 4 and 10 p.m.

Exemption Applications.—An appeal was made at Leicester for an electrician at a local kinema (C 3), previously rejected, who is substituting a Class A man now in the Navy, and who has undergone an operation for appendicitis and peritonitis. Exemption was refused.

At Radcliffe (Lancs.), exemption was applied for an assistant electrical engineer, apprenticed to a firm doing practically all Government work, and who had been discharged from the Army after four months' service. The appeal was refused as from the end of January.

The Lancaster Tribunal have granted six months' exemption to an electrical installation engineer (42, C 3), who is in charge of the installation at a mansion converted into a military hospital.

At Southampton, the Corporation tramway department appealed for exemption for five employés. The manager said that substitutes—discharged Army men—had been sent, but they left. One was given six months with a view to substitution, and the others were each temporarily exempted for a similar period.

West Kent Appeal Court has granted one month's exemption to H. W. Whitaker (18, Grade 3), assistant electrician at the Theatre Royal, Chatham.

Before the East Kent Appeal Court, exemption was claimed for H. G. H. Dearle (39, C 1), stoker, with the Isle of Thanet Traction & Lighting Co., Ltd., and he was given until June 17th.

An appeal was made by the Military against exemption held by F. Stillingfleet (24, B 1), electrician at Underley Hall, near Kendal. Major Hope Brown, for the Military, contended that there was no need for an electrician at the Hall, but the estate agent replied that the man was in charge of the turbine for the electric lighting, and was a valuable man. The appeal was dismissed, and the exemption confirmed.

Dorset Appeal Court heard an appeal by the National Service Representative against temporary exemption until February 28th allowed to H. J. Barrow (36), electrical wireman with Messrs. Brooking & Co., electrical engineers, of Weymouth. Captain Chubb suggested that Barrow would be an excellent man for the engineers. The appeal was disallowed, and the exemption confirmed.

At Peterborough, exemption was claimed for F. Woodman (42, B 2), tramway traffic inspector, and E. A. Sewter (31, B 2), mechanic on the tramway maintenance and repairing staff. Each was allowed three months.

The Essex Appeal Court heard a Military appeal against exemption until March 1st allowed to G. A. Weston (38, B 1), electrical engineer, Westcliff, Southend-on-Sea. He has charge of the electrical fittings at hospitals and council schools, and the exemption was granted on the ground of domestic hardship and national interest. The appeal was refused, and the exemption confirmed.

On a National Service review, the Chippenham Tribunal has granted exemption until April 15th to F. Foyle (41, Class A), who is in charge of the electric plant at the cloth factory.

At Lewes, the Electric Supply Co., Ltd., appealed for renewed exemption for R. Woodward (27, general service), shift engineer, on the ground of certified occupation. Captain Selby Ash objected, as appellant had not attended the Volunteer drills. Woodward explained that the other assistant was away on Admiralty work. He was supposed to relieve him (applicant) at 6.30 p.m., but sometimes he had to wait until 8 p.m., and sometimes until 10.30 p.m. He had to remain until the other man came. He sometimes had to work 14 and 16 hours per day, and he had to work on alternate Sundays. The exemption was renewed until April 4th, appellant to join Section B of the Volunteers.

At St. Ives (Hunts), Messrs. Enderby & Co. appealed for S. J. Allen (B 1), engineer in charge of new electrical driving plant and machinery, and four months were conceded.

LEGAL.

KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING CO., LTD., *v.* THE NOTTING HILL ELECTRIC CO., LTD.

THE hearing of this action was continued before Mr. Justice McCardie on Thursday, December 20th.

MR. TOMLIN, K.C., for the Notting Hill Co., detailed the findings of Mr. J. Swinburne, which were published in the ELECTRICAL REVIEW of October 12th, and concluded by submitting that the Arbitrator's award was wrong, and he had not correctly construed the agreements.

MR. VESEY KNOX, on behalf of the Kensington and Knightsbridge Electric Co., submitted that the award should be upheld. Counsel argued that the point taken by Mr. Tomlin with regard to the Kensal Town supply—viz., that it could not have been given unless it was given by the Metropolitan Co.—was not open to him, and that Mr. Tomlin was not entitled to put before the Court the statement of facts on which to found his argument. The maximum power taken last year by both the companies was less than half of the capacity of the joint station, and there had always been an enormous surplus of current. There never had been any question of limitation of output. Mr. Tomlin had claimed that the Notting Hill Co. had taken 600,000 watts, and had done all that they were required to do; but that was a misapprehension of the object of the relevant clauses, as these dealt with the limitation of the maximum demand. The clauses limited the amount which during a certain specified period could be taken from the joint station. The joint station had, at all relevant times, been ready and willing to give any supply required by the Notting Hill Co.

MR. JUSTICE MCCARDIE said that difficult matters were arising with regard to the facts found by the arbitrator. If they were to get on with the hearing, they must try to formulate some common basis of facts.

MR. TOMLIN said that the capacity of the joint station had been increased from time to time, and, instead of being limited to 1,800 KW., it was now 9,000 KW. His clients had, in regard to the total, always taken a fair proportion provided for in the agreements. There had been times when the station had not been in a position to give them all that they wanted.

The hearing of the case was continued on Friday, December 21st, and MR. TOMLIN, K.C., replied on behalf of the Notting Hill Co. He said the root question in the case was: What was the contract the Notting Hill Co. had entered into, and what had they contracted to do? If they had contracted to do something that was within their powers, and had not carried it out, they were liable in damages, but if it was not within their powers, they were not liable in damages because there was no contractual obligation of which there had been a breach, as they never had the contractual capacity to bind themselves by any such obligation. Upon the agreement there were two limitations—the supply was to be within the

statutory area, and there was to be "a reasonable amount" taken. As the Kensal Town area was outside of the statutory area, if he was right, that concluded the whole point in his favour. Counsel also submitted that it could not be contended that as the arbitrator had found damages there was an end of the matter. The award had been framed in an alternative sense by Mr. Swinburne. The Kensington Co. could only found a claim on a breach by the Notting Hill Co. of a valid obligation, and they had to show that there was an obligation of which there was a breach, and in respect of which a claim for damages arose. There had been a supply to an area outside the statutory area which was *ultra vires*, and the Kensington Co. were now seeking to say that the Notting Hill Co. were bound to take the supply from the joint station "for any purpose"—even if it was illegal or *ultra vires*.

At the close of the arguments, as mentioned in our last issue, MR. JUSTICE MCCARDIE reserved his judgment until the 1918 sittings.

BUSINESS NOTES.

Catalogues —MESSRS. VICKERS, LTD., Electrical Sales Department, Vickers House, London, S.W.1.—We recently mentioned a number of pamphlets which had been issued in foreign languages by this company as part of its foreign propaganda scheme. We have now received some further examples of this collection. One is a 60-page brochure produced in the same excellent style, containing a considerable number of finely executed half-tone views of the electrical machine shops of the company and typical examples of its electrical machinery manufactures, including A.C and C.C. generating plant, rotary converters and motor-generators, C.C. and A.C. motors, and motor-driven machinery. In all cases there is brief letter-press in several languages. A special Russian edition of this brochure is now in the press. Two little blotter slips, with illustrated backs, are printed in colour, about as artistically as anything of their kind that we have seen.

Calendars, &c.—MESSRS. PECKHAM, DUCAMP & CO., of 90, Charing Cross Road, W.C., have prepared a useful desk Reminder Book of very presentable appearance. Each page consists of a week's ample daily memoranda spaces, and will either turn over at the top or tear off.

From MESSRS. ALEX. HAWKINS & SONS, of London Road, Southwark, S.E. 1, we have received an artistic wall calendar, small monthly date slips being fastened beneath a charming reproduction in colour of "The End of a Perfect Day."

THE HART ACCUMULATOR CO., LTD., of Marshgate Lane, Stratford, London, in accordance with their now long-established custom, have prepared a desk blotting pad, with the calendar for 1918 arranged in two halves on either side of the pad.

THE WESTMINSTER TOOL AND ELECTRIC CO., Suffolk House, Laurence Pountney Hill, Cannon Street, London, E.C. 4.—Small hanging wall calendar with monthly slips for 1918.

From MESSRS. HILL, UPTON & CO., LTD., of 22, George Street, Oxford, we have received a wall calendar with distinctly printed monthly slips, lighting times and moon changes being indicated in red ink.

THE SUN ELECTRICAL CO., LTD., of 118-120, Charing Cross Road, London, W.C. 2, have prepared a set of refills for their desk calendar for 1918. They will be pleased to send a set to any reader who has the metal base; unfortunately, as the circumstances of the time preclude the manufacturing of more metal bases at present, they are unable to forward complete calendars.

Once again we are indebted to the BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, for one of their large, businesslike wall sheet calendars. On each monthly sheet for 1918 there are printed, as before, in smaller type, the dates for the preceding and the following months. A bird's-eye view of the Rugby works, and a half-tone illustration of plant made by the company, appear on each sheet, together with addresses of the B.T.H. branch offices.

MESSRS. TAYLOR & CHALLEN, Derwent Works and Foundry, Birmingham.—Wall calendar for 1918, with a set of perpetual changing date cards.

MESSRS. SIMPLEX CONDUITS LTD., of Garrison Lane, Birmingham, have again sent us one of their useful pocket diaries, which not only admirably serves its main purpose, but also contains a quantity of engineering information and data. In addition we have received an ingenious ashtray, representing one-half of a Simplex four-way box, and an excellent leather pocket wallet, all of which items we highly appreciate.

Trade Announcements.—MESSRS. WOOLNOUGH, LANG, LTD., of Acton, have changed their name to Lang & Squire, Ltd., but the management of the firm is unaltered. Mr. Woolnough has had no interest in the company for some years. The company is now in a much stronger position to give prompt deliveries.

In connection with the death of MR. WM. JOHNSON, it is announced that the business of Messrs. Wm. Johnson & Co., electrical contractors, of 49, Leopold Street, Sheffield, will be continued under the management of Mr. H. J. Burdett.

Liquidations.—RESISTO ELECTRICAL MANUFACTURING CO., LTD.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. De Westley Layton, Thorner's Chambers, Ingram Court, Fenchurch Street, E.C. 3, by January 18th.

Book Notices.—"The Function and Place of Advertising in Modern Business Economics," with particular reference to the attitude of Government Departments to advertising. Issued by the Council of the Association of British Advertising Agents, London.

We have received copies of further issues of the B.E.A.M.A. *Journal*, printed in Spanish and Russian respectively. London: B.E.A.M.A., Oakley House, Bloomsbury Street, London, W.C. 2.

"Radio Communication Theory and Methods." By J. Mills. London: Hill Publishing Co. Price 7s. 4d. net.

"Central Stations." By T. Croft. London: Hill Publishing Co. Price 10s. 6d. net.

"Lighting Art." By M. Luckiesh. London: Hill Publishing Co. Price 10s. 6d. net.

"Circular of the Bureau of Standards." No. 68. Public Utility Service Standards of Quality and Safety. Washington: Government Printing Office. 5 cents.

The "Electrical Engineer's Diary," 1918. Edited by J. H. Johnson, M.I.E.E. London: S. Davis & Co. Price 6s.

Auction Sale.—MESSRS. W. HOUGHTON & CO. will sell by auction on January 30th, at the Mart, Tokenhouse Yard, various leasehold properties in Gt. Marlborough Street, and Foubert's Place, suitable for electrical engineers and manufacturers. See our advertisement pages to-day.

For Sale.—Leeds Corporation Electricity Department is inviting offers for a quantity of surplus plant, including engines, alternators, and condensing plant. For full particulars see our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Alton.—PROV. ORDER.—The U.D.C. has decided to oppose the application of the Aldershot Gas, Water, and District Lighting Co. for a prov. order for electric supply to parishes in the area of the R.D.C., in view of the fact that the Council before the war gave instructions for an electrical scheme to be prepared for Alton and adjoining rural parishes, and had postponed the scheme on account of the war.

Australia.—Uralla (N.S.W.) Municipal Council has applied for authority to carry out an electric light scheme. Armidale City Council has received a further offer to install electric lighting in the town from the Hellgrove and Armidale Water-Power Electric Co., which, under an old Act of Parliament, possesses legal authority to supply electricity in the district. The company proposes generating by water power at a site 10½ miles from the city.

The Lighting Committee of the South Grafton Municipal Council has recommended acceptance of the electric lighting proposal of Mr. J. N. Webber, of the Clarence River Timber Co.; under the scheme the Council will have the right to acquire the distributing system and battery to be erected, at such time as the Nymboida hydro-electric supply is an accomplished fact.

The city electrical engineer at Goulburn, N.S.W., has reported favourably on the question of substituting electric for steam power at the water works pumping station.

A conference of a number of towns, convened by the Goulburn Chamber of Commerce, is urging the Government to proceed with the Burrinjuck hydro-electric scheme.

In the Railways Bill now before the Victorian Parliament, provision is made for the sale of electrical energy in bulk by the Railway Commissioners; strong objection is being taken to the measure by the Melbourne City Council, because it would be possible for the bulk-supply business of the Council, on the expiration of agreements, to be transferred to the Railway Commissioners, and thus injuriously affect the financial stability of the Council's undertaking; also because it would empower the Commissioners to supply electricity to the Board of Works pumping station, the Harbour Trust, the new post office, and the Government cold stores, which are at present supplied by the Council. The Railway Commissioners, it is argued, would have power to "pick and choose" their consumers, and would naturally take the largest and most profitable. It is therefore urged that the Bill be withdrawn and that a conference be held between the Railway Commissioners and the Electric Supply Committee of the City Council, with a view of introducing an amending Bill to the next session of Parliament.

Mr. H. Frew, civil engineer, Brisbane, recently laid before a special meeting of the Townsville Council, Queensland, a scheme for a septic tank generating septic gas and providing power for electric light. Mr. Frew laid two proposals before the meeting—one a full installation, which would cost £23,400, and a smaller scheme, costing £13,900 for installation.

Aylesbury.—The T.C. has undertaken to supply Mr. Jas. Putman, of Haydon Hill, at a cost of £270, Mr. Putman paying £200 towards the cost, and guaranteeing at least £15 a year for 10 years. Current is also to be supplied to the mill of Mr. E. P. Collier at ¾d. per unit.

Ballyshannon.—An application from cottage tenants to the D.C. for the introduction of electric light in the dwellings, was met by the chairman (Mr. T. Gorman) with the remark that if a 10 years' guarantee were given, no objection would be offered.

Belfast.—The recent strike at the power station was settled by the men agreeing to return to work on the understanding that if the Order of the Ministry of Munitions is extended to semi-skilled and unskilled men, the Corporation will act on it as from the date applying to skilled men. The electrical service was maintained by volunteer workers from Corporation departments.

Braintree.—PROPOSED E.L.—Both the Crittall Manufacturing Co., and the U.D.C., have given notice that they are applying for powers for electric lighting. It is estimated that the contest will cost the ratepayers £300, equal to an addition of 4d. to the local rates.

Branstone. — Tutbury R.D.C. has consented to the Burton-on-Trent T.C. erecting a high-tension overhead line for the supply of current to a new factory.

Cavan.—Mr. J. F. Tierney, C.E., has reported to the B. of G. on the purchase of plant for the proposed installation of electric lighting in the workhouse, estimating that over £300 had been saved by the transaction.

Dorking.—PRICE INCREASE.—The Electricity Co. has increased the price of current for lighting from the date of the next quarterly meter readings by a further 5 per cent., making a total advance on pre-war rates of 20 per cent.

Dudley.—PRICE INCREASE. — The Electric Lighting Committee, on the application of the Power Co., recommends the Council to agree to an increase in the price of electricity by 12½ per cent.

Gainsborough.—PROV. ORDER.—The U.D.C. has decided that it is expedient to oppose the application of Mr. Jas. Marshall, of Messrs. Marshall, Sons & Co., Ltd., for a prov. order.

Grantham.—PRICE REVISION.—The Urban Electric Supply Co. announces that from January 1st consumers supplied on the weekly payment system will be charged 2d. in the 1s. extra per week for the eight winter months, instead of 1d. as at present, and slot meter consumers will be charged 4d. in the 1s. extra, instead of 2d.

Greenock.—YEAR'S WORKING.—The annual report by Mr. F. H. Whysall, burgh electrical engineer, on the working of the Corporation electricity undertaking during 1916-17, shows that the total output sold amounted to over 21 million units, an increase of 11·3 per cent. on the previous year. Greenock took 16,874,344 units, Port Glasgow 2,988,262 units, and traction absorbed the remaining 1,263,035 units. The total income for the year was £96,843, while the gross profits amounted to £42,062, and, after meeting interest and sinking fund charges, and providing £5,000 for depreciation, there remained a net surplus of £10,831, as compared with £6,998 in the previous year. The average total works cost was ·616d. per unit, as against ·659d., although the average price of coal was 1s. per ton more than during 1915-16, the reduction being entirely due to economies in generation, as a result of careful tests to ascertain the best conditions of working in the boiler house and engine room. The total connected load was 27,279 KW., and the maximum load 7,783 KW. The load factor improved from 28·99 per cent. to 31·02 per cent., while an increase of ·01d. over last year was obtained in the average price received per unit for the whole supply. The two new 30,000-lb. boilers installed in December, 1916, and the new cooling tower of 310,000 gallons per hour capacity have enabled considerable economies in generation to be made. The refuse destroyed at the destructor amounted to 15,063 tons, wages costing 2s. 0½d. per ton destroyed; 1,064,135 units were generated by the steam raised, and the value of these at ·35d. per unit was £1,552.

During the past year the installation and hire department has sent out electric heating apparatus having a capacity totalling 393 KW.; altogether 282 motors and other appliances, representing 466 KW., were installed by the department during the year. The capital account now amounts to £404,841, of which £96,857 has been repaid; of the net surplus £7,781 has been added to the reserve fund, which now stands at £41,200, and £3,050 has been transferred to the burgh general assessment account.

Halifax.—PRICE INCREASE.—The Electricity Committee proposes to increase the charges for lighting and heating by 12½ per cent.

Haslingden.—PRICE REVISION.—The General Purposes Committee has had under consideration the price paid by the Corporation for electricity, and decided that the following amended scale of charges should come into operation on January 1st, viz.:—Lighting purposes, 5d. per unit; heating and ordinary power consumers, a further increase of 10 per cent. on original scale price, making a total increase of 25 per cent.; tramways, a flat rate of 1½d. per unit, as and from April 1st, 1917. With regard to the increase in the price per unit to be charged to special power consumers under agreement, they had agreed to forego the terms set out in the respective agreements, and were prepared to pay an additional figure based on the Accrington Corporation's works costs.

Hebden Bridge.—The Council, in Committee, has decided to oppose the Yorkshire Electric Power Co.'s Bill.

High Wycombe.—STREET LIGHTING.—Subject to an approved agreement for street lighting, the T.C. has accepted the offer of the Electric Light and Power Co. to accept £500 instead of £600 in respect of street lighting for 1916, and the pending action at law has been stayed for one month by the company without prejudice.

Hull.—NEW PLANT.—On Saturday last the Lord Mayor officially started a new 5,000-KW. Dick, Kerr turbo-alternator at the Corporation electricity works. The turbine is of the impulse type, running at 1,500 R.P.M. and exhausting into a surface condenser; it is coupled to a 6,600-volt, three-phase alternator, with an overload capacity of 25 per cent. for two hours and 50 per cent. for five minutes. Two large water-tube boilers have been added in the boiler house, equipped with inclined grate mechanical stokers designed to burn 2 tons and 30 cwt. of low-grade slack respectively per hour. An electro-hydraulic coal tipper and telpher grab have been installed in connection with the overhead bunkers.

Kingston-on-Thames.—The Electricity Committee has received a reply from Edmundson's Electricity Corporation, stating that while the company is not prepared to alter the essential terms of the offer, if the Committee would indicate in what respect it considered the offer not acceptable, the company would carefully consider any suggestions which might be put forward.

The Committee has informed the Council that it was such essential terms that were unacceptable, so that if the company desired to reopen the matter it was for it to make proposals more satisfactory in essentials.

Leeds.—LINKING-UP.—The Ministry of Munitions has recommended the consideration of a linking-up scheme in connection with the Leeds and Bradford electricity undertakings, and the subject is now being considered by the officials concerned. The application from the Corporation for consent to the carrying out of the scheme of electricity extensions has been refused by the Ministry, but authorisation has been granted for a 6,000-KW. plant, at an estimated cost of about £35,000. The Electricity Committee has conditionally accepted a tender for the work from Messrs. Richardsons, Westgarth & Co., at £29,790, and sanction to the tender is being awaited from the City Council.

Leek.—PROPOSED LOAN.—The U.D.C. has decided to make application to the L.G.B. for sanction to borrow £1,250 to provide additional plant for the electricity works, the Ministry of Munitions having consented to issue a certificate for it.

Leyton.—PRICE INCREASE.—The U.D.C. has decided to advance the price of electricity for light and power from the commencement of the Lady Day quarter by 13½ per cent., making a total increase since the war of 33½ per cent. The charge to the tramways department is to be further advanced by 5 per cent., making a total of 10 per cent.

Llandudno.—The Council has received a report from Mr. Patchell on the supply by the Council of electrical energy to the Llandudno and Colwyn Bay Electric Railway. Mr. Patchell decided that the traction business had not yet been done at a loss, although the margin of profit had almost disappeared; an increase in the price of energy supplied for traction and lighting was desirable, particularly as the top price might not yet have been reached in fuel. The Council might give the Electric Railway Co. notice to terminate the arrangement for the supply of current for traction purposes, or it might accept the company's offer of increased rates in consideration of a modified form of Sunday running. Before giving notice to the company of discontinuance of traction supply in 12 months' time, the E.C. was authorised to re-open negotiations, and to report at the next meeting.

London.—HAMPSTEAD.—The Council has decided to abolish the maximum demand system of charging for electricity, and six months' notice is to be given to those consumers of electricity now charged upon that system to terminate their agreements at midsummer, 1918.

Morecambe.—PRICE INCREASE.—From March 31st the price of electricity will be 3½d. instead of 3d. per unit for power, and 6½d. instead of 6d. for lighting, with a minimum charge of 10s. 10d. per quarter on all lighting consumers and of 5s. 10d. per quarter on power consumers.

Newport (Mon.).—PRICE INCREASE.—The Electricity and Tramways Committee has recommended a further increase of 15 per cent. on all electricity charges excepting bulk supply contracts. It has also decided to cancel until further notice the two-rate meter scale, as it was found that a very large number of smaller consumers were taking advantage of the scale to obtain their supply at exceptionally low rates.

The electrical engineer reported to the Committee that serious delay had occurred in the delivery of extension plant at the East power station; the matter is to be taken up with the Ministry of Munitions.

New Zealand.—In the Government Public Works statement authority is proposed to be taken for the raising of £136,000 for the development of water power.—*Tenders.*

Northampton.—PRICE INCREASE.—The Electric Light and Power Co. announces a further increase in the price of power of 10 per cent. as from the Christmas meter readings.

Norwich.—PRICE INCREASE.—The City Council has decided to make an addition of 5 per cent. to the charges for electricity for lighting and heating and 10 per cent. for power as from the reading of the meters for the Christmas quarter, 1917.

Stalybridge.—PRICE REVISION.—The Joint Board has decided that the following alterations be made in the charges for electricity as from January 1st.:—Lighting, 4½d. per unit, less 5 per cent.; mill and factory lighting, 3d. per unit net; heating supplies, 1½d. per unit net; theatre and cinema tariff, plus ½d. per unit; cotton mill power supplies, 5 per cent. on standard scale.

Stockport.—The electrical engineer reported that he had offered to fix lamps on the tramway overhead equipment in the Cheadle and Gatley district at £3 each, and to maintain and light the same at a further cost of £3 per lamp. The Cheadle Council considers the charges too high, and asks for a reconsideration of the same.

United States.—To assure an adequate supply of electric power for factories the Government has requisitioned the electric power produced, imported, and distributed by the Niagara Falls Power Co., the Hydraulic Power Co. of Niagara Falls, and the Cliff Electric Distribution Co. There had been some adjustment to war industries before, but the new order will intensify the arrangement.—*Daily Chronicle.*

TRAMWAY AND RAILWAY NOTES.

Australia.—The Melbourne Tramways Board Bill extending the term of the present Board until October 31st, 1918, has passed the third reading in the Victorian Legislative Assembly.

The report of the N.S.W. Railway Commissioners for the September quarter on the working of the Government tramways, is particularly interesting, as it shows the effect of the strike. The gross earnings were £346,539 as against £482,337, a decrease of £135,798; working expenses amounted to £314,030, as against in 1917 £394,030, a decrease of £80,015; and the net revenue was £32,500 as against £88,292, a decrease of £55,792. The car-miles run were 3,809,354 as against 6,463,650, a decrease of 2,654,305, and the passengers carried 48,308,318 as against 71,714,876.—*Sydney Daily Telegraph.*

Blackburn.—TRAFFIC FIGURES.—During the 276 days running in the year 1917-18 up to and including Boxing Day, the receipts on the tramways amounted to £58,880, an increase of £9,546 on the takings for the same period a year ago.

Bradford.—The Christmas holiday tramway receipts show a four-days' total £1,026 in excess of those of 1916.

Owing to some abuse of the privilege, the free travelling tokens granted to soldiers at the local recruiting offices have been withdrawn.

Halifax.—REVISED FARES.—It is understood that tramway fares are about to be advanced by 50 per cent., and that transfers are to be abolished, and various other modifications of the service introduced, owing to the difficulties of the times.

ACCIDENT.—A serious runaway tramway accident occurred last Friday, resulting in the death of a cart driver from injuries and the electrocution of one of his horses. The rails were greasy, and the car got out of control whilst descending a hill, and crashed into the back of a coal cart; the car subsequently collided with a switch-box fixed to one of the tramway standards, and when the box was smashed and the cables fused the shaft horse was killed by electric shock. The car left the rails, but remained upright, and nobody on board was hurt

WAGES.—The War Wages Committee has declined the recent applications by the Amalgamated Association of Tramway Workers for increased wages. The Committee has also submitted the following resolution for the approval of the T.C.:—"That the Halifax Corporation view with alarm the continual applications for increases of wages and war bonus from the employés engaged by Corporations and other public bodies, seeing that the rates of increase of wages already given are, in the opinion of this Corporation, in excess of the actual increased cost of living, while continual accretion of the wages bill is tending to produce unrest in other sections of the community. Further increases will compel Corporations to have recourse to State assistance, and this Corporation urge the Government to give the matter their earnest consideration, and at the same time to give instructions to the Committee on Production that, in deciding any future applications, the Committee must fix a time limit within which no further applications should be considered; and, further, that a copy of this resolution should be forwarded to the Prime Minister, the Chancellor of the Exchequer, the President of the L.G.B., the local Members of Parliament, and also to the various County Borough Councils in the West Riding, asking such Councils to pass a similar resolution, and forward the same to the above-mentioned Government Departments and to their local Members of Parliament."

Lancashire.—Despite the unpopularity of their action and the serious inconvenience caused to the public, the tramway employés of Manchester, Salford, Rochdale, Burnley, and other towns in Lancashire refused to work on Christmas Day.

Leeds.—PARCELS SERVICE.—At a meeting of the Tramway Traffic Sub-Committee, it was reported that a Committee had been formed in connection with the use of the tramways for the distribution of parcels in the suburbs, and a number of representative tradesmen have been invited to join it, with a view to restricting the use of motor-cars and horse vehicles owing to probable further drastic reductions in petrol supplies and feeding stuffs. A scheme has been formulated, and this is awaiting the approval of the B. of T.

Mansfield.—The T.C. has asked the Light Railway Co. to pay an increased price for energy supplied.

Tramway Wages.—Applications are to be made on behalf of tramway employés of 19 authorities in Lancashire and Cheshire for a further advance in wages of 10s. per week.

TELEGRAPH AND TELEPHONE NOTES.

Argentina.—A wireless station has been set up at Plomer, in the Argentine Republic, under the supervision of the firm of Siemens-Schuckert. It has a range of 15,000 km., and thus can communicate with Nauen, near Berlin. Trial messages transmitted from Germany were received at the Plomer station, although not sufficiently clearly to be intelligible, owing to the intense atmospheric phenomena.—*Industria e Invenciones.*

Australia.—The telephone service shows a profit of £18,000, as compared with a loss of £270,000 during the previous year.—*The Times.*

Continental.—DENMARK.—The Valdemar Poulsenske Syndekat has taken over the Aktie-Selskab Dansk Telefonfabrik, and will now exclusively make the smaller wireless installations for ships. The company is stated to have already a large number of orders in hand, for delivery immediately on the cessation of hostilities.—*Teknisk Tidsskrift.*

Japan.—H.M. Commercial Attaché at Yokohama writes that the Japanese Department of Communications wishes to establish in future a large new wireless station, which will develop the same transmission power as that at Funabashi, which is the largest plant in Japan. Wireless communication between Japan and Hawaii and the United States is steadily increasing, but at present the Funabashi station is the only one that is open to public use. The Funabashi plant, however, belongs to the Japanese Navy, and it is reported that the Department of Communications is desirous of establishing a new station exclusively for the benefit of the general public, at an estimated cost of about £71,500. It is also reported in this connection that the Department has decided to erect a wireless station in the Ojika Peninsula, Akita Prefecture.

The only important concern making wireless apparatus in Japan appears to be a company at Tokio, which is said to be very busy at present constructing wireless sets for the large number of ships now being built in Japan. The company is a fairly new one, with a capital of £25,000, of which half is paid up. The apparatus which it manufactures is known as the "Japanese system," and is said to be a combination of various European and American inventions.—*B. of T. Journal.*

The Pacific Cable.—The report of the Pacific Cable Board for the year ended March 31st, 1917, shows that the receipts were £336,774, the expenditure £155,848, and the surplus, after placing £90,000 to the renewal fund, was £90,926. Of this sum £77,545 was paid in respect of interest and sinking fund, and £9,150 to the renewal fund for the New Zealand cables, leaving a net balance of £4,231. In the previous year the contribution to the renewal fund was £30,000, and this year a special contribution of £10,000 has been made to the provident fund, to meet the depreciation of securities. The surplus will be applied to the reduction of debt. The traffic receipts increased by £26,127, and the expenses by £13,951. The renewal fund investments at March 31st were valued at £291,067, with cash in hand £73,829, and cable valued at £65,293.

Throughout the year the cables suffered no interruption and required no repairs; the long sections were working at full load day and night during the whole year. The landlines also have worked well. Electric lighting and power plant is being installed at the Suva station in place of the existing acetylene gas plant. Sir Wm. H. Mercer retired from the Board, and was succeeded by Mr. H. C. M. Lambert. The special war allowance to the staff has been increased to 20 per cent. of net salary for the year 1917; and as most of the members were entitled to extended leave, which, under war conditions, could not be taken, leave rights have been commuted to the value of £3,500.

During the year nearly nine million paying words of international traffic were transmitted by the Pacific Cable, as well as 650,000 words relating to wounded members of the Field Forces gratis; the traffic exceeded that of the previous year by 1¼ million words, and has practically reached the limit of capacity with existing types of apparatus. The Board also carried 1,795,200 paying words between Australia and New Zealand and the Pacific Isles. At times of congestion it has been found necessary to suspend certain services, or to transfer a portion of the traffic to the Eastern Co. The week-end telegram service has been suspended since July, 1916, in the outward direction, and since November, 1916, in both directions. The outward deferred Press service has been suspended since August, 1916, and the deferred ordinary service on outward traffic since June, 1917, but it is hoped that the latter may be restored in the near future.

CONTRACTS OPEN AND CLOSED.

OPEN.

Argentina.—February 23rd. Rosario Municipality. Establishment of telephone service within the municipal radius. Conditions on application.

Bolton.—January 15th. Electricity Committee. One 7,500-KW. turbo-alternator with condensing plant. See Official Notices" December 7th.

Keighley.—January 9th. Electricity Department. Induced draught plant. See "Official Notices" December 21st.

Manchester.—January 16th. Electricity Committee. Rotary converter or motor converter plant. See "Official Notices" December 28th.

February 2nd. Waterworks department. Electrically-driven radial arm crane. See "Official Notices" to-day.

Tipperary.—January 11th. New battery for the Union electric lighting plant. See "Official Notices" December 21st.

CLOSED.

Australian Contracts.—Mr. H. R. Harper, city electrical engineer, Melbourne, has sent us the following information regarding recent tenders for electrical plant:—In November, 1916, the Council advertised for tenders for a 7,500-K.V.A. turbo-alternator, returnable March, 1917. When tenders came to hand, however, it was decided to postpone consideration of them, in view of the decision of the Government to consider the inauguration of a State supply of electricity in bulk, generated on one of the brown coal fields for which Victoria is noted.

The tender for a 2,000-KW. rotary converter put forward by the Australian General Electric Co., for a set made by the General Electric Co., U.S.A., at £6,601, f.o.b., was accepted. In view of the impossibility of obtaining any plant from British manufacturers until after the war, the order was placed with an American firm, as it was essential that this plant should be in operation for next winter.

With the object of carrying out tests with inferior coals, the Council, in May, 1916, placed an order with the Erith Engineering Co., London, for two Erith Riley stokers complete with fans and hydraulic controls. The Erith Co., however, were unable to obtain a priority certificate for the manufacture of these stokers, and as the Sanford Riley Co., U.S.A., were able to guarantee delivery within a reasonable period, the order has recently been transferred to the American company.

MELBOURNE.—Electricity Committee. Accepted tenders:—
1,000 500-watt gas-filled metallic filament lamps, £850.—Australian General Electric Co.
Two 3-phase, 100-K.V.A. transformers, £299.—Sutherland & Ashman.
200 lanterns for gas-filled lamps, £668.—R. Bryce & Co Pty., Ltd.

SYDNEY.—Metropolitan Board of Water Supply and Sewerage. Electrically-driven air compressors for the N. Sydney Works. Ingersoll Rand Co., £6,291.

Electric Lighting Committee. Tenders recommended:—
Australian General Electric Co.—3,100 5-amp., A.C. meters, £4,050; 1,700 10-amp, do., £1,361 10s.; 200 25-amp. do., £295; 40 50-amp. do., £89 10s. and spare parts (£100), making the total tender price £5,987. These prices do not include ocean freight or insurance, estimated at £460, which will be paid by the Council.—*Tenders.*

Victorian Railway Department. Tenders accepted:—
Bare H.D. 17/18 S.W.G. copper cable, 2s. 10d. per lb.; rubber-insulated E.L. cable, 7/18 S.W.G., £63 10s. per mile; 7/20 S.W.G., £41 per mile.—W. T. Henley's Telegraph Works Co., Ltd.—*Tenders.*

TASMANIA.—LAUNCESTON. City Council. Accepted tenders:—
3,650 metal filament lamps, £ 60.—Edison Swan Electric Co., Ltd.
3,300 " " " £243.—Australian General Electric Co.
7,250 " " " £538.—Aust. General Electric Co.—*Tenders.*

Barnes.—U.D.C. Cable: Pirelli-General Cable Works, Limited.

Brighton.—B.G. Electrical fittings: Mr. H. J. Gallier, Brighton, £43.

Bradford.—Guardians. Contract with Waygood-Otis, Ltd., for maintenance of lifts, continued at increased charge of 20 per cent.

Derby. The T.C. has accepted the following tenders for the electricity and tramway departments:—
Babcox & Wilcox, Ltd.—Boiler, £4,500.
C. A. Parsons, Ltd.—4,000-KW. turbo-alternator, £24,000.
T. W. Brackett & Co., Ltd.—Water screen, £355.
Firth, Blakeley, Sons & Co., Ltd.—Chimney, £230.
Holmes Bros., Ltd.—Tramcar wheel tires, £53.

Hull.—T.C. Extra-high-tension switchgear: British Westinghouse Co., Ltd., £1,284.

Ilford.—U.D.C. 1,000 tons of nutty slack coal for the electricity works: Messrs. Blackman & Co., £1 1s. 11d. per ton.

Lancaster.—T.C. Boiler repairs and electric welding at the electricity works: J. L. Gordon, Liverpool, £35.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturday, January 5th. At 3 p.m. At Albemarle Street, Piccadilly, W. 1. Christmas Lectures, "Our Useful Servants: Magnetism and Electricity": (Lecture V) "Electric Dynamos, Motors, Transformers and Railways." Tuesday, January 8th, (Lecture VI) "Electric Telegraphs and Telephones."

nstitution of Civil Engineers.—Tuesday, January 8th. At 5.30 p.m. At Gt. George Street, S. W. Papers on "Rail Creep," by Mr. F. Reaves, and "Creep of Rails," by Mr. H. P. Miles.

Liverpool Engineering Society.—Wednesday, January 9th. At 8 p.m. At the Royal Institution. Paper on "Refrigerator Installation for Carriage of Ships' Provisions," by Mr. J. B. Wilkie.

Association of Engineers-in-Charge Wednesday, January 9th. At 8 p.m. At St Bride's Institute, Ludgate Circus, E.C. Paper on "The Human Factor in Modern Production."

Institution of Electrical Engineers.—Thursday, January 10th. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Electrical Signalling and Control on Railways," by Mr. C. M. Jacobs.

(Scottish Local Section)—Tuesday, January 8th. At 7 p.m. At Princes Street Station Hotel, Edinburgh. Paper on "Electrical Cooking as Applied to Large Kitchens," by Mr. W. A. Gillott.

Greenock Electrical Society—Thursday, January 10th. At 7.45 p.m. At 22, West Stewart Street. Paper on "Small Private Plants," by Mr. G. T. Morrison.

Electro-Harmonic Society.—Friday, January 11th. At 8 p.m. At the Holborn Restaurant (Venetian Chamber), Smoking concert.

London Association of Foremen Engineers. Saturday, January 12th. At 7 p.m. At Cannon Street Hotel, E.C. Presidential address by Mr. B. M. Campbell.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, January 12th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Cable Complaints," by Mr. J. H. C. Brooking.

OUR HALF-YEARLY INDEX.

As it is necessary to effect every possible economy in paper consumption, the Index to Vol. 81 of the ELECTRICAL REVIEW, which will be printed in the course of a few days, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make application therefor promptly to: The Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

NOTES.

Electro-Harmonic Society.—The next Smoking Concert will be held at the Holborn Restaurant, in the Venetian Chamber, on Friday, January 11th, at 8 p.m. The artistes will be as follows:—Mr. Anderson Nicol, tenor; Mr. Harry Morton, concertina; Mr. Ben Lawes, humorist; Mr. Arthur Backner, musical monologues ("Rubinstein at the Piano"); Mr. Robert Pitt (baritone), and Mr. Langton Marks (humorist and pianist), in ragtime duets and humorous "Business" at the piano; Mr. Bernard Flanders, A.R.A.M., sole pianoforte and accompanist.

Destruction of a German Power Station.—The *Times* states that by the explosion at an explosives factory at Kirchbaumvasen, near Karlsruhe, last week, a large new electrical station, furnishing power to the Imperial Nitric Acid Works, was completely destroyed.

The Wages of Central-Station Employes.—Mr. H. Faraday Proctor, hon. secretary of the I.M.E.A., recently circulated to the engineer members of the Association a memorandum relating to wages and awards.

The memorandum states that the awards of the Committee on Production are only binding upon the parties to an agreement which was come to between the Engineering Employers' Federation and certain Trade Unions, except that they have also been made applicable by an extending Order issued by the Ministry of Munitions to certain undertakings. Those members who have not been advised that their department is one of the undertakings to which the extending Order applies, are not bound by the awards of the Committee on Production.

At a meeting held at the Ministry of Munitions on December 10th, when the I.M.E.A. was represented by Mr. Beauchamp and Mr. Proctor, it was explained that the 12½ per cent. award, and also the awards of the Committee on Production, did not, broadly speaking, apply to such undertakings, although they might be certified undertakings under the Munitions of War (Amendment) Act, and it appears desirable whilst such conditions exist that any advances granted should be made on purely local grounds. If any particular awards are followed a precedent may be formed, and in the event of other awards being made compulsory upon electricity undertakings, the one series of awards might be super-imposed on the other awards, although such was not the intention.

The 12½ per cent. is to apply only to men in the engineering trade and moulders. Referring to tramway and electric supply undertakings, it was stated that where undertakings had repair shops, the repair shop would come under the "engineering trade," but the remainder of the works, such as the generating station, was not "engineering trade." The award does not, therefore, appear to be absolutely compulsory outside the repair shops, unless a precedent has been or is created.

Standardisation of Tramway Overhead Construction.—A sub-committee of the Municipal Tramway Association upon the question of "Standardisation of Overhead Construction" has held a meeting at Leeds. The work of this Committee is of a very far-reaching and important nature, dealing as it does with the standardisation and drawing up of the specifications for every overhead fitting used in tramway work, including trolley wires and trolley wheels. The object to be attained is to standardise everything possible, so that after the war tramway undertakings will be able to get good deliveries and reasonable prices due to the fact that manufacturers will not have to keep such large stocks. At the present time there are as many as 50 to 100 different forms and types of one fitting—each engineer having his own ideas and the

manufacturers having to hold a stock of each. The work will occupy a considerable time and will necessitate collaborating with the American Tramway Standardisation Department and with the British Engineering Standards Committee.

The Coal Conservation Sub-Committee's Report.—As might be expected under the circumstances, the electric supply proposals involved in the above report have called forth considerable comment in different parts of the country.

Ald. Pearson (Bristol), hon. solicitor to the I.M.E.A., pointed out that that body had never opposed a scheme for improving the electrical supply of the country. He regretted that the Coal Conservation Committee, on which there was no municipal representative, had issued a report which they might reasonably expect to have received from the Board of Trade Committee on Electrical Power Supply now sitting; also that it favoured company as against municipal working at a time when this matter was being considered by the latter Committee, and particularly that the operations of one company are dealt with, as proving, in some degree, the correctness of the opinions set forth in the report. Cheap electricity was necessary to progress, and cheap money was essential to success; the latter could more easily be obtained by a municipality than a company, and still more easily by the Government.

Mr. H. Faraday Proctor (Bristol), hon. sec., I.M.E.A., agreed with most of the proposals, but took exception to comparisons of municipal and company working in favour of the latter. The question was, however, one for the B. of T. Committee now sitting. He welcomed the idea of larger areas.

Mr. S. L. Pearce (Manchester) interviewed on the subject, mentioned that the Lancashire and Cheshire authorities already had a scheme for their area very much on the lines suggested in the report; this would require the approval of the B. of T. and it might be that the larger scheme would absorb the local one, but until the B. of T. Committee considered the whole matter it was difficult to forecast the result.

[It is worth noting here that at a recent conference of 31 authorities of Lancashire and Cheshire interested in the local scheme, the linking-up proposals were agreed in principle, but the second portion of the proposals, relating to the constitution of one financial authority to take over the responsibility of the existing undertakings, was rejected by 21 votes to 10.]

Mr. Harrison Barrow (Birmingham), discussing the report, objected to the favouritism being shown to private enterprise because "it seemed to be an attempt at reaction from municipal to capitalistic control." The proposals would result in a great monopoly, and the company directors would apparently have entire control subject to some rather nebulous National Commission. He entirely agreed that the present municipal areas of electricity supply were unsatisfactory.

Mr. S. E. Fedden (Sheffield), at an interview, admired the scheme on paper and from the point of view of coal saving, but doubted whether it would give Sheffield cheaper electricity. The North-East Coast power scheme was not a fair criterion on which to base judgment for the entire country. The majority of the big industrial centres, like Manchester, Birmingham, and Sheffield, were not touched by tidal waters, and in such places cooling towers would have to be erected. Distant stations would involve tremendous transmission difficulties unless the Government acquired the land compulsorily. The existing vested interests would be another huge obstacle. For Sheffield he thought the project was outside the realms of practicability for the present, and it would be suicidal for them to delay their present scheme for a plan which was but in the theoretical stage. Their new power station would give them over 100,000 KW., making, with the existing plant, a total of 168,000 KW.

Mr. W. A. Chamen (South Wales E P S. Co.) interviewed on the question, said there was no doubt that, if worked to the best advantage, the requirements of Cardiff, Newport, and those of his company could be best supplied from one large station; the three engineers, in these cases, were agreed on this in principle. [Mr. Nichols Moore (Newport) has, however, since pointed out that this was only agreed as one of three possible solutions.] One large power station would also supply Swansea, Neath and Llanelly more economically. He had no knowledge of much waste heat in South Wales, as the collieries used it themselves, but there was an opportunity of putting down by-product plant in connection with superstations. The question of the method of applying the scheme rested with the B. of T. He added that the South Wales Linking-up Committee would issue its report shortly.

Mr. R. P. Sloan (Newcastle E S. Co.), interviewed on the report, mentioned that the North-East Coast power companies had on order some 27,000-H.P. generating sets, which would be installed on a site on the River Tees, where accommodation would be provided for a large coal carbonisation plant. The Newcastle Co. had for some time been experimenting on low-temperature coal carbonisation, and lately on a fairly large scale, and they hoped to effect large economies.

Concerning the control of electrical undertakings by a Board of Commissioners, Mr. Sloan thought that if the Board acted in a judicial rather than executive capacity it would be beneficial to the supply industry. In his opinion, the problem of supplying electricity throughout a large area was totally different to that of supplying large towns; the North-East Coast power companies, and possibly one or two other power companies, were the only undertakings which had the necessary experience to any great extent. The generating and supply of electricity should be under one control, whether municipal or company.

Both Mr. Sloan and Mr. Starr (of the Clyde Valley Power Co.) disagree with certain statements made by Mr. Lackie (Glasgow) defining the position of municipal undertakings in regard to cheap electricity supply.

Mr. Lackie considered that the progressive reduction in the cost of electrical energy must be increasingly in favour of municipalities on account of the manner in which the latter were compelled to repay borrowed capital.

The Ministry of Munitions and Restrictions on Cable Laying.—Correspondence has passed between Mr. H. Faraday Proctor, hon. secretary of the I.M.E.A., and the Director of Electric Power Supply regarding a communication, dated December 8th, relating to the use of cables for the connection of additional consumers.

The letter from the Ministry of Munitions states that until further notice the Ministry of Munitions will raise no objection to additional connections being made to supply mains, subject to compliance with the following conditions:—

1. That adequate generating plant capacity is available.
2. That no lead-covered cable is used on the connection.
3. That the cost of the connection (including any mains extensions) to be borne either by the undertaking or by the consumer does not exceed £10.
4. That the manager forwards to the Director of Electric Power Supply at the end of each month a list of consumers connected during the month, giving name, address, purpose, kilowatts installed, and cost of connection.

It is not desirable to connect new consumers who already have alternative methods of obtaining light, heat, or power, or business premises not used for direct or indirect war work. No connection, the cost of which will exceed £10, or in which lead-covered cable is required, may be made until the sanction of the Department has been obtained.

In reply to an inquiry from Mr. Proctor, a further letter states that it is desirable that existing stocks of lead-covered cable should be husbanded as carefully as possible. Lead-covered cable should not, therefore, be used for making house connections, except in accordance with the directions set out above.

In reply to Mr. H. A. Howie, manager of the Walsall Corporation electric supply department, the Director of Electric Power Supply said that even in the case of direct war work accompanied by a certificate, no connection the cost of which exceeded £10 should be made without the sanction of the Department. A certificate for any expenditure must be applied for, and be granted direct to the manager. No new cable could be purchased without a permit, and when it was necessary to order additional cable, an application should be made stating the length, type, and cost of the cable required.

On December 22nd Mr. Proctor wrote to the Director as follows:—

"With further reference to your letter of December 8th, I have been requested by sundry of our members to ask you to give your kind consideration to the suggestion that the £10 limit which you impose as the maximum to be expended on the cost of connecting a consumer should apply only to the cost of the cable alone, or, at the worst, to the cost of all material, cable, duct, boxes, &c.—that is to say, excluding the cost of all labour, supervision, and establishment charges from such £10 limit, for the reason that work carried out under the conditions you mention will no doubt in every undertaking be carried out by the regular maintenance staff—that is to say, no further call upon the labour market would be made in the execution of such work. I trust that you can see your way to agree to this."

In reply, the Director of Electric Power Supply said:—"I am directed to acknowledge receipt of your letter of the 22nd inst., and in reply thereto am to say that the £10 limit does not necessarily prevent the connection of a consumer, but it necessitates an application to this Department for sanction. In every case where the limit exceeds £10 and electrical undertakers consider the circumstances justify their submitting an application to me for decision, the same will always receive every consideration. In the meantime, however, I am willing that the £10 shall exclude labour, so long as no outside labour is employed, and you may advise your members to this effect. It was not intended that the limit should include supervision and establishment charges."

The following is a copy of a resolution passed by the Harrogate Electricity Committee on December 31st, 1917:—

"That the Committee protest against the arbitrary interference with the conduct of the local electricity supply as set forth in the communication from the Ministry of Munitions of December 8th last and interpreted by the subsequent correspondence. Economy in the use of lead for new cables may be desirable, but the use of lead-covered cable already in the local stores might reasonably be left to the discretion of local undertakers. The monthly return of business asked for entails considerable extra work, and in view of the imperative call for man-power for the direct prosecution of the war, it is difficult to appreciate either the need for such data or how a staff can be found in a Government Department to give time and attention to such comparatively minor and unimportant details."

Prize Awards.—The Académie des Sciences has awarded the Gaston Planté Prize to M. Henri Armagnat for his experimental researches in electricity. The Hughes prize has been awarded to M. Amédée Guillet for physics, especially a study of damped vibrations.

The Royal Dublin Society's Boyle Medal has been awarded to Prof. J. A. McClelland, Sc.D., F.R.S., for research in many branches of science, but primarily in those which deal with ionisation as resulting from additions of electrons to gaseous molecules, or aggregates of such, and the more recently discovered forms of radiation associated pre-eminently with radio-activity.

Volunteer Notes.—COUNTY OF LONDON VOLUNTEER ENGINEERS (FIELD COMPANIES).—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week ending January 12th, 1918, by Lieut.-Colonel C. B. Clay, V.D., commanding :—

Officer for the Week.—Lieut. W. J. A. Watkins.

Next for Duty.—Second Lieut. H. G. Golding.

Monday, January 7th.—No. 3 Company, 6.30—9.30. Recruits' drill, 6.30—8.30, Signalling Section, 6.30—9.30.

Tuesday, January 8th.—Lecture on "Demolitions" at 6.30. Physical drill, 7.30.

Wednesday, January 9th.—No. 1 Company, entrenching, &c., at 6.30. Recruits' drill, 6.30.

Thursday, January 10th.—No. 2 Company, entrenching, &c., at 6.0. Recruits, 6.30. Signalling Section at 6.30—8.30. Ambulance Section at 6.30—8.30. Medical examination of recruits at 6.30.

Friday, January 11th.—Musketry, 5.30—8.

Saturday, January 12th.—Knotting, lashing and splicing at 2.45. Musketry, 2.45—4.45.

All drills will be at Headquarters unless otherwise stated.

(By order) MACLEOD YEARSLEY, *Capt. and Adjutant.*

"The Rarer Key Minerals."—The following letter came to hand after our "Correspondence" columns had been closed :—

"In your issue of December 28th last a letter appears from the British Thomson-Houston Co. commenting on a report of my recent lecture upon the above subject, and stating that I was misinformed regarding the production of ductile tungsten filaments in this country before the war. This is not the case, however, as the statement made at the lecture was to the effect that before the war ductile tungsten filaments were not being produced on a commercial scale in this country *from the ore*. This fact is substantiated by the details in the letter from the B.T.H. Co.

"The *final* stages in the manufacture of the filaments were certainly carried out in this country before the war, but, so far as I could ascertain, no firm was at that time manufacturing ductile tungsten filaments from tungsten ore. The imported manufactured products which were, at that time, used by the various firms *as the starting point*, were pure tungstic oxide or tungsten rod.

"It would appear from their own statement that the B.T.H. Co. had to devote at least a year to investigation before they could bridge the gap between tungsten ore and their previous starting point, *i.e.*, pure tungstic oxide.

"SYDNEY J. JOHNSTONE.

"New Barnet, *January 1st*, 1918."

Scottish Linking-up Proposals.—The West of Scotland Committee, dealing with this matter, has issued its conclusions ; it proposes to divide into four electrical groups an area which includes the counties of Renfrew, Clackmannan, Linlithgow, and portions of the counties of Ayr, Lanark, Dumbarton, and Stirling. One of these groups comprises the Glasgow Corporation area and that of the Clyde Valley Power Co. ; the linking-up of the Glasgow group would cost about £16,000, and the estimated saving thereby is put at £10,000 a year.

Institution and Lecture Notes.—The Röntgen Society.—At the meeting of the Röntgen Society on December 19th, Prof. J. W. Nicholson, F.R.S., read a paper in which he described some recent work by M. de Broglie, of Paris, with regard to the discovery of absorption spectra of X-rays. The rays after being generated are separated off into a spectrum by a crystal which acts as a diffraction grating, and the spectrum of the radiation is recorded on a photographic plate. Into the path of the radiation various elements, usually in the form of very thin sheets of metal or sheets of paper painted over with compounds, are interposed which are capable of absorbing the rays to a varying extent, and thus the spectrum of the particular metal or other interposed substance is obtained. Prof. Nicholson showed lantern slides of very many of these absorption spectra, and said that the general result was to establish the essential identity of X-rays and ordinary light in every respect except in the order of magnitude of the wave length. In this respect there was a complete difference ; the spectroscopic investigations had again proved the extreme smallness of the wave length of X-rays, which was practically of the same magnitude as the radius of an atom. One remarkable example shown was the X-ray spectrum of tungsten and of certain other components, and in this instance the positions of the various lines were as marked as in the ordinary spectrum of visible light, which indeed it very much resembled. At the same meeting Mr. Charles A. Schunck, F.C.S., read a paper on "The Region of the Ultra-violet Spectrum of Greatest Therapeutical Effect." As a result of working with carbons, metallic tungsten, and the mercury-vapour lamp, and judging the therapeutical effectiveness by the production of an erythema reaction, Mr. Schunck came to the conclusion that the region of greatest effect was among the very shortest wave lengths, from 2,540 to 2,380. Dr. Sydney Russ, however, combated this view, and thought that too much attention had been paid to these very short wave lengths, and that the very active germicidal region, between wave lengths 2,960 and 2,880 had been overlooked.

Electrical Association of Australia (Victorian Section).—On November 1st, at Melbourne, Mr. Victor Nightingall read a paper, illustrated by experiments, on "The Possibilities of the Luminescent Lamp by the Discharge of Electrons in High Vacua."

Institution of Civil Engineers.—On Wednesday the Institution of Civil Engineers completed the hundredth year of its existence, having been established in 1818 at a meeting of eight engineers at the Kendal Coffee House in Fleet Street.

At the next ordinary meeting of the Institution on Tuesday, January 8th, before the discussion of papers, a statement commemorative of the founding of the Institution on January 2nd, 1818, will be made, present conditions precluding more formal celebration of the centenary.

Association of Mining Electrical Engineers.—At a meeting of the Yorkshire Branch on Saturday last, at Barnsley, a paper on "Economies in Colliery Electrical Plant" was read. It was estimated that electrical power to the extent of something like one million horse-power was at present in use in British collieries. The principal directions in which economies could be effected were in the utilisation of low-grade coal and gas from by-product plants for steam-raising purposes.

South African Institution of Engineers.—The following awards have been made for the past session :—Institution's Gold Medal and Certificate : Mr. Andrew Fenwick, for his paper on "The Deterioration of Curtis-Rateau Turbine Blading." Central Mining-Rand Mines Award : Messrs. T. C. Otley and Verney Pickles, for their joint paper entitled "Boiler-house Operation and Maintenance." Price Award : Divided between two theses, entitled respectively "Comparative Merits of Steam Turbines and Reciprocating Engines," by Mr. M. Kindinger, and "The Lay-out of a Distributing Station, with Special Reference to Safety Measures," by Mr. W. H. F. Tredre (student members).

Appointments Vacant.—Two charge engineers for the Hereford Electricity Works ; charge engineers (50s.) for the R.E. York. Command ; power station staffs for the Ordnance Depôts, aerodromes, and military camps in the Southern Command ; switchboard attendant (51s.) for the Battersea B.C. Electricity Department ; shift engineer (42s. +) for the Swansea Harbour Trust ; sub-station attendant (49s.) ; cable jointer for the Stalybridge, &c., Joint Tramways and Electricity Board ; assistant engineer, shift engineer, and draughtsman for Edmundson Electricity Corporation ; switchboard attendant (35s. +) for the Walthamstow U.D.C. Electricity Department ; shift engineer for Keighley Borough Electricity Works ; shift engineer for Eccles Corporation Electricity Department. See our advertising pages to-day.

The Siemens Shares.—The *Daily Mail* states that after long negotiations between the Board of Trade and several syndicates of would-be purchasers, "a contract has been entered into for the sale of the German shares in Siemens Bros., Ltd., of Woolwich and Stafford, electrical engineers. The successful syndicate consists of British-born subjects. It is their intention to carry on and expand the business, which has been supported by Government war contracts."

Raising the Price of Gas.—In the Bill by which the South Metropolitan Gas Co. proposes to alter its powers, the company asks that its capital may be increased by £1 000,000, and for the purposes of dividends that the sliding-scale charge shall be increased from 3s. 1d. to 3s. 7d. per 1,000 cb. ft. This increase is "to continue for two years after the termination of the war" or such longer period as the Board of Trade may determine.—*Daily Chronicle.*

Educational.—Recognising how important it is that technical education should be fostered, Messrs. J. Stone & Co., Ltd., of Deptford, S.E., are encouraging the boys employed in their works to take full advantage of the valuable facilities afforded by the evening classes of the L.C.C. and other institutions in the neighbourhood. Prizes will be awarded on the results of the class work, and to induce those who are not already attending such classes to take advantage of the scheme and begin their technical training at once, the company is paying the fees of a number of boys for whom three new special classes are now being opened. The L.C.C. officials have very readily undertaken the organisation and tuition for these special classes, and it is hoped that the encouragement given the boys (over a hundred are affected by the scheme) will have permanently good results.

Advanced Electric Light Switching.—A few weeks ago we commented on the issue of a new Preliminary Grade Exam. Paper in Electric Light Switching ; we have now received a new paper dealing with the Advanced Grade. The first line of the first question reads, "Modern tumbler switches have either 2, 3, 4, 5, or 6 terminals," and will remind many people that their knowledge of this fact, and all that it leads up to, is imperfect. The paper comprises 14 questions in all, and examinees may work 8, 9, or 10 of them. The questions cover an extremely wide range. For example, No. 3 deals with the testing and sorting of wires when the time comes to fit the switches of a certain circuit ; No. 5 with tube wiring ; No. 8 with C.T.S. ditto ; and No. 11 with earthed concentric. Other questions relate to the uses of special tumbler switches in heater, small motor, and instrument circuits. Anyone can obtain a copy of the paper by applying to Messrs. A. P. Lundberg & Sons, 477-489, Liverpool Road, London, N. 7.

Re-Opening of the Science Museum.—The Science Museum, South Kensington, was re-opened to the public on Tuesday last, after having been closed to them for nearly two years ; it has, however, been open without interruption for students. The greater part of the Museum will be open free on every week day from 10 a.m. to 5 p.m., and on Sundays from 2 30 p.m. to 5 p.m.

The collections contain many unique objects of great interest as representing discoveries inventions and appliances that have been of first-rate importance in the advancement of science and industry, and it is gratifying that these are again available for inspection by visitors to London from all parts of the Empire. In our opinion the closing of this and other science museums was a grave error on the part of the authorities.

Calendars Wanted.—Lieut. F. L. Cater, A.M.I.E.E., will be glad if manufacturers will send some 1918 calendars for workshop and office use, addressed to him as follows :—882 M.T. Company, A.S.C., Halkin Street, London, S.W. 1.

OUR PERSONAL COLUMN.

Central Station and Tramway Officials.—Mr. ROBERT HUNTER, who has occupied the position of station engineer for the greater part of the 19 years that he has been associated with the Aberdeen Corporation electricity department, recently tendered his resignation. On December 26th the staff and employés held an informal meeting in the works to bid him farewell. Mr. Bell presided, and expressed regret at Mr. Hunter's departure. The other speakers were Messrs. Clark, Burnett, McKay, Ross, Fyfe, and Downie. In the name of those present Mr. Bell, on behalf of the staff and employés, presented Mr. Hunter with a gold albert and a suitably inscribed silver matchbox.

A letter has been received by the Leeds Tramways Committee from the Board of Admiralty thanking the Corporation for placing the services of Mr. J. B. HAMILTON, the tramways manager, at their disposal during the past year, and paying a high tribute of appreciation to the excellent work which he has done, and the knowledge and ability he has displayed. The Admiralty express the hope that his services may again be placed at their disposal if required, although in the meantime he has been transferred to the Board of Trade in connection with the Tramways Control Committee appointed to deal with congested tramway traffic in munition areas. In that office it is hoped Mr. Hamilton may be able to assist the Tramways Committee in obtaining essential labour and material from districts in which at the moment they are not so urgently required. The Committee have conveyed to Mr. Hamilton their congratulations on the Admiralty letter, and have extended to him the privilege of placing his services at the disposal of the nation, keeping in touch meanwhile with local matters.

The Newport (Mon.) Council has confirmed a recommendation of the Electricity Committee that Mr. NICHOLS MOORE be granted a further increase in salary of £50 per annum as from January 1st.

The Todmorden Council has granted an advance of £50 per annum in the salary of the borough electrical engineer, Mr. JOSEPH BOYCE.

General.—We regret to learn that Mr. T. H. HARRISON, of Messrs. Davey, Paxman & Co., Ltd., London, was seized with paralysis down his left side on December 7th. He is at present living at 26, Abbey Road, Brighton. Although he is now better, it will be a long time before he is about again. We are sure that Mr. Harrison's numerous friends and admirers in the electrical world will be anxious to join with us in sympathising with him in his enforced inactivity, and in expressing a hope that his recovery may be as speedy as possible.

Mr. LEE MURRAY has removed his offices from 10, Norfolk Street, Strand, W.C. 2, to 56, Victoria Street, Westminster, S.W. 1.

Mr. H. W. TEETON, electrical engineer, who is in business at Hanley, has received a commission in the Motor Transport, A.S.C. On the outbreak of war he was mobilised with the Staffordshire Yeomanry, and on the expiration of his time in January, 1916, he entered the Army Service Corps as an electrician. After 18 months' service in France he was recommended by his Colonel for a commission. He has now gone to the Eastern theatre of war. In his absence his business is being carried on by his wife.

Mr. HERBERT R. KEMP, on the staff of the Yorkshire Electric Power Co., has been appointed electrical and mechanical engineer to Messrs. J. H. Andrew & Co., Ltd., Toledo Steel Works, Sheffield.

Roll of Honour.—We regret to record that the younger son of Mr. C. G. Tegetmeier, of the British Electric Traction Co., Ltd.,—ALAN TEGETMEIER, of the London Regiment—has been killed in action, aged 26 years. Private Tegetmeier was on the staff of the British Electrical Federation.

The Military Medal for bravery and devotion to duty by keeping telephone lines in repair under shell-fire has been awarded to Signaller T. C. OWEN, King's Shropshire L.I., who was an electrician with Messrs. Smallwood & Co., of Shrewsbury.

Corporal J. CLEATOR, who has died of wounds received in action, served his apprenticeship with Mr. John Ellwood, electrician, of Whitehaven.

Private G. MCKELVEY, reported killed after being missing since April, was, up to his enlistment, a meter inspector in the electricity department of the Ilford U.D.C.

Rifleman W. PASSMORE, who has died in a French hospital from the effects of gas poisoning and bronchitis, was an electrician at Swansea.

Corporal C. W. HORLEY, Sherwood Foresters, who has died of wounds, was in the winding department of the B.T.H. Co., at Rugby.

Private S. HUGHES, Royal Welsh Fusiliers, who was an electrical engineer at Llanfair (Montgomeryshire) when he enlisted at the outbreak of war, has gained the Military Medal for repairing telephone wires under heavy shell-fire.

Drummer H. PICKLES, West Yorks. Regiment, who is in hospital with trench fever, was employed by Mr. Harry Moss, electrician, Bradford.

Pioneer W. A. HAYES, R.E., who has been killed at the Front, was with Messrs. T. Garnett & Co., electrical engineers, Manchester.

Private T. HARRINGTON, Connaught Rangers, awarded the D.C.M., was a motorman on the Bury Corporation tramways.

Lieut.-Col. A. B. LAYTON, South Lancs. Regiment, who has again been mentioned in dispatches, was electrical engineer and departmental manager at the works of Messrs. J. Crosfield & Sons, Ltd., Warrington.

Private G. H. PARKINSON, of the K.S.L. Regiment, who has died of wounds, was employed by Messrs. Baxendale and Co., Ltd., Manchester.

Private G. WALKER, of the Middlesex Regiment, who has been awarded the Military Medal, was in the superintending engineer's office connected with the Leeds General Post Office.

WILLIAM HOWARTH, electrical artificer, has lost his life by the sinking of the armed boarding steamer *Stephen Furness* in the Irish Sea. He was 22 years of age, and prior to joining the Naval Reserve was an electrician with a Manchester firm.

Private NEWTON, Leicestershire Regiment, who has fallen in action, was engaged as electrician at Swynnerton Hall.

Private R. S. LONGDEN, of the electrical department of the North Staffordshire Railway Co., has been killed in action.

Sapper P. HIRST, formerly in business as an electrician at Huddersfield, has been wounded.

Lance-Corporal J. LYNCH, one of the employés in the Stockport electricity department, has been awarded the D.C.M., and the Council has forwarded its hearty congratulations.

Lieutenant (S.R.) EGERTON J. WARD, A.M.I.E.E., Royal Irish Regiment, mentioned in Sir Douglas Haig's recent dispatch for gallant service on the Western Front, was on the staff of the Pará Electrical Railways & Lighting Co., Ltd., Brazil.

Obituary.—SIR W. H. LINDLEY.—The *Times* records the death, which occurred at Putney on Sunday, at the age of 64 years, of Sir William Heerlein Lindley, M.Inst.C.E., who had for very many years been engaged in a prominent capacity in connection with Continental waterworks, electrical undertakings, sewerage works, &c. Among other works with which he was concerned were the electricity works at Elberfeld. The *Times* states that "the regard in which he was held in German engineering circles is shown by the fact that he acted as president of the Engineering Standards Commission of the German Gas and Waterworks Engineers, and also of the commission on stray electric currents from tramways. He became a member of the Institution of Civil Engineers in 1878, and received a knighthood in 1911 on the ground of the services he had rendered to the Royal Commission on Canals and Waterways, for which he prepared elaborate reports on the waterways of France, Belgium, and Germany, with some notes on those of Holland."

MR. E. W. NEWTON.—The death occurred on December 30th, at the age of 44 years, at Monkseaton, of Mr. Edgar Williams Newton, of H.M. Postal Telegraphs.

MR. REUBEN MARCHANT SAYERS.—We much regret to announce the untimely death from typhoid fever of Mr. R. M. Sayers, A.M.Inst.C.E., M.I.E.E., partner in the firm of Messrs. Clark, Forde, Taylor & Erskine-Murray. Mr. Sayers was educated at St. Paul's School, and was trained in electrical and engineering work at the City and Guilds Institute, South Kensington, of which he was a prominent student. In 1897 he joined his firm as an assistant engineer, and for 20 years has been associated in the important works which they have undertaken. Those whose privilege it had been to know him intimately for all of those years know that his ability and character earned everyone's esteem, and the many letters received are eloquent testimony of the regard felt for him as an engineer and as a man who endeared himself to all with whom he came in contact in the course of his career. Sayers's first work on submarine cables was in connection with the laying of the Bermuda-Turk's Island-Jamaica Cable in 1898, and in the 19 years following he led a busy life, acting as chief assistant, and afterwards (in 1910), when he became a partner in the firm, on many cable-laying expeditions, amongst which may be mentioned the Pacific cable and the laying of the Commercial Co.'s cables as under:—Fayal (Azores) and Canso (Nova Scotia), Weston-super-Mare and Waterville (Ireland), New York and Havana, diversion of Atlantic cable to St. John's, Newfoundland, extension of St. John's-Canso cable to New York, and several successful deep-sea repairing expeditions, in all of which he carried out the work undertaken to the full satisfaction of his firm and of the cable companies for whom he was acting. Mr. Sayers possessed abilities in such a marked degree, and was so earnest in all he undertook, that he will leave his mark on the calling which he had chosen, and for which he was especially fitted by sound knowledge, ability, and charm of manner. He contributed papers on electrical subjects to the technical journals, and amongst those we have in mind are: "Use of the Electrometer in Cable-testing," "Temperature Coefficient for Loss of Charge of Paraffin Paper Condensers," &c., &c. Quite recently he attacked the difficult problem of computing the depreciation of submarine cables, and his death has deprived us of an important paper on this subject. His services to the various cable companies for whom he has acted have been recognised in the fullest and most sympathetic way. He was not a man who courted publicity, but the amount of "spade work" that he did for his firm and their clients is most highly spoken of by those who deplore the loss of a dear friend.

NEW COMPANIES REGISTERED.

Watertight Fittings, Ltd. (149,159).—Private company. Registered December 18th. Capital, £1,000 in £1 shares. Manufacturers of and dealers in watertight fittings in connection with the supply of electricity for lighting, heating, and power, or in connection with any trade, &c. The subscribers (each with one share) are:—R. Eyre, Ryland Works, Chesterfield, merchant; J. J. Eyre, Holywell Street, Chesterfield, house furnisher. The first directors are to be appointed by the subscribers. Solicitor: W. E. Wakerley, Chesterfield, Derby.

Berry's Electric, Ltd. (149,161).—Private company. Registered December 18th. Capital, £50,000 in £1 shares. Electrical and general engineers, &c. The subscribers (each with one share) are:—H. H. Berry, 86, Newman Street, W., engineer; F. G. Kerly, 10/11, Austin Friars, E.C., solicitor. The first directors are to be appointed by the subscribers. Registered office: 86, Newman Street, Oxford Street, W.

Northumbria Motors, Ltd. (149,201).—Private company. Registered December 31st. Capital, £25,000 in £1 shares. Electrical, mechanical, hydraulic, and general engineers and contractors, manufacturers of machinery, tins, lamps, dynamos, engines, rheostats, and electrical apparatus, dealers in motor cars, wagons, cycles, and tri-cars (steam, petrol, gas, or electric), &c. The subscribers (each with one share) are:—W. O. Sykes, Northlands, Horbury, near Wakefield, athletic goods manufacturer; S. Cox, 8, Cotton Street, Wakefield, cashier. The first directors are to be appointed by the subscribers. Solicitor: J. Charlesworth, The Crofts, Horbury, near Wakefield, Yorks.

Pyne, Hughman & Co., Ltd. (1,638).—Particulars filed December 19th, 1917. Registered in Calcutta March 1st, 1916, to take over the business of Pyne, Hughman & Co., and to carry on the business of engineers, builders, contractors, ironfounders, electrical engineers, ship, boat, carriage, and motor builders, &c. Capital, Rs. 3,10,000 in 3,100 shares of Rs. 100 each. British address: 329, High Holborn, W.C., where F. M. Short (manager in the United Kingdom) is authorised to accept service.

British Expert Engineers & Precision Tool Manufacturers, Ltd. (149,193).—Private company. Registered December 20th. Capital, £4,000 in 1,400 pref. shares of £1 each and 300 ord. shares of £5 each, and 26 founders' shares of £25 each. Precision tool manufacturers, electrical, heating, mechanical, and general engineers and metal workers, &c. The subscribers are:—E. A. Boynton, 37, Church Lane, Hornsey, N., engineer, 14 founders' shares; F. C. Dowsett, 100, St. George Avenue, Tufnell Park, N., engineer, 12 founders' shares. The first directors are:—E. A. Boynton and F. C. Dowsett. Registered office: 22, Cross Street, Islington, N.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rapid Distillation & Power Co., Ltd.—Charge dated December 6th, 1917 (supplemental to charge of November 27th, 1917), securing £15,402 of and all moneys which may be paid by Lieut.-Col. W. G. Morden and C. W. Small under a certain guarantee. Property charged: The company's undertaking and property, present and future, except uncalled capital.

Chamberlain & Hookham, Ltd. (59,920).—Capital, £100,000 in 10,000 ord. and 10,000 pref. shares of £5 each. Return dated June 14th, 1917 (filed November 20th). 10,000 ord. and 8,000 pref. shares taken up; £36,490 paid on 7,298 pref.; £33,510 considered as paid on the remainder.

Brecknell, Munro & Rogers, Ltd. (79,766).—Capital, £20,000 in 2,000 pref. shares of £5 each and 20,000 ord. shares of 10s. each. Return dated November 19th, 1917. 1,058 pref. and 14,829 ord. shares taken up; £5,673 10s. paid on 1,058 pref. and 767 ord.; £7,031 considered as paid on 14,162 ord. Mortgages and charges: £7,900.

Pirelli, Ltd. (103,068).—Capital, £40,000 in £5 shares. Return dated October 26th, 1917. All shares taken up; £40,000 paid. Mortgages and charges: Nil.

New St. Helens & District Tramways Co., Ltd. (59,426).—Capital, £150,000 in 20,000 pref. and 10,000 ord. shares of £5 each. Return dated November 9th, 1917. 15,980 pref. and 9,000 ord. shares taken up; £125,410 paid, including £510 on 1,020 shares forfeited. Mortgages and charges: Nil.

Blackburn, Starling & Co., Ltd. (61,302).—Capital, £12,000 in £1 shares. Return dated July 27th, 1917. All shares taken up. £8,100 paid; £3,900 considered as paid. Mortgages and charges: Nil.

Guildford Electricity Supply Co., Ltd. (36,725).—Capital, £55,000 in 25,000 pref. shares of £1 each and 6,000 ord. shares of £5 each. Return dated September 10th, 1917. 18,856 pref. and 3,059 ord. shares taken up. £34,153 paid, including £2 on two ord. shares forfeited. Mortgages and charges: £40,000 (£25,000 first and £15,000 second mortgage debentures).

Drake & Gorham, Ltd. (70,275).—Capital, £125,000 in £1 shares. Return dated November 22nd, 1917. All shares taken up. £85,000 paid; £19,000 considered as paid. Mortgages and charges: Nil.

British Electric Traction Co., Ltd. (49,855).—Capital, £2,998,337 15s., of which, to July 6th, 1917, £712,744 5s. had been issued as 6 per cent. cumulative participating preference stock and £1,326,263 10s. as ordinary stock. Total amount paid: £2,039,007 15s. Mortgages and charges outstanding at date named: £1,866,042.

Ely Valley Lighting Co., Ltd. (78,637).—Capital, £5,000 in £1 shares. Return dated November 15th, 1917. 3,471 shares taken up; £3,473 10s. paid, including £2 10s on 10 forfeited shares. Mortgages and charges: Nil.

Frinton-on-Sea and District Electric Light & Power Co., Ltd. (70,689).—Capital, £10,000 in 7,300 pref. and 2,700 ord. shares of £1 each. Return dated July 26th, 1917. All shares taken up; £10,000 paid. Mortgages and charges: £10,000.

Yorkshire Cable Co., Ltd.—Satisfaction in full on November 6th, 1917, of debenture dated June 19th, 1912, securing £1,200.

Satisfaction in full on November 6th, 1917, of debenture dated October 8th, 1914, securing £800.

Debenture dated December 10th, 1917, to secure any sum, not exceeding £4,000, which W. Stell and R. R. Stell may be called upon to pay under a guarantee. Property charged: The company's undertaking and property, including uncalled capital.

Rushmores, Ltd.—Particulars of £30,000 debentures created December 19th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees

H. T. Boothroyd, Ltd. (99,742).—Capital, £20,000 in £1 shares (15,000 ord. and 5,000 pref.). Return dated December 3rd, 1917. 10,002 ord. and 2,800 pref. shares taken up. £2,802 paid on 2,800 pref. and two ord.; £10,000 considered at paid on 10,000 ord. Mortgages and charges: £7,509.

Enfield Electric Cable Co., Ltd. (131,995).—Capital, £50,000 in £1 shares. Return dated November 6th, 1917. 32,800 shares taken up. £32,800 paid. Mortgages and charges: £35,000. (Various enemy holdings have been eliminated during 1917.)

Dartmoor Electric Supply Co., Ltd. (110,871).—Capital, £2,000 in 10s. shares (reduced from £4,000 in £1 shares in 1916). Return dated June 30th, 1917. All shares taken up. £2,000 paid. Mortgages and charges: £4,000.

CITY NOTES.

The Société Industrielle des Téléphones.

The report of the directors of the *Société Industrielle des Téléphones, of Paris*, which has an ordinary share capital of £720,000, and owns several works for the manufacture of telephone and submarine cables, ebonite, electrical apparatus, &c., was submitted to the general meeting held on December 15th. It deals with the year ended on June 30th, 1917, and states that the continuation of the war caused an increase in the consumption of telephone cables, and of all other products required for purposes of national defence. The company's efforts still further to develop the production were redoubled, and the turnover notably increased. As, however, the general expenses did not advance in the same proportion the net profits permitted of the payment of a dividend of £1 12s. per share, notwithstanding the considerable rise in wages, raw materials, and of taxation. If this immediate result was satisfactory, the situation was not without causing pre-occupation on account of the excessive wear and tear of the machinery and plant. The scarcity of trained workers had compelled the company to entrust the plant to a *personnel* who were frequently inexperienced, and the necessity for day and night working increased the depreciation. As a consequence, it was proposed to apply a sum greater by £40,000 than in the previous year to the writing down of the installations. This augmentation was not excessive when it was considered that the almost complete renewal of the equipment would be necessary after the cessation of hostilities, and that as its original value would be completely redeemed by that time the expenditure on replacement would then exceed twice the pre-war cost. It was for this purpose that the directors also asked, after the payment of the dividend, the transfer from the balance of £64,000 to the prevision fund which was formed in the previous year. As was mentioned in the report for 1915-16, it was essential for the company to have available the necessary resources for the reorganisation of the works after the war in order to ensure the future prosperity of the undertaking and maintain the position which it had occupied in the industrial world for 25 years. It was, therefore, intended to proceed by way of extensions, so as to avoid any interruption in working, and obtain the best arrangements. Sites had been acquired for these purposes adjoining the works in the Rue des Entrepreneurs et de Levallois for the extension of telephony and apparatus, and adjacent to the Bezons works for new shops and the transfer of a portion of the rubber manufacturing. The accounts show a credit balance of £313,000. After placing £100,000 to the depreciation fund, £29,000 to the legal reserve fund, £64,000 to the prevision fund, and making other appropriations, the balance permits of the payment of £1 12s. per share, or at the rate of 13¼ per cent.

British Columbia Electric Railway Co., Ltd.

The directors' report for the year ended June, 1917, shows that after making provision for renewals maintenance £101,459, income-tax £15,000, and addition to capital amortisation fund £2,762, the net revenue is £160,844, plus £6,860 brought forward, and £44,000 transferred from reserve (in order to make the dividend payment), making £211,704. Interest on debenture and debenture stock for the year absorb £132,671, and dividends already paid on the 5 per cent. cumulative perpetual preference stock for the year £72,000, leaving £7,033 to carry forward. The above figures represent an improvement of approximately £26,000 over the results of the previous year. The report of the Government Commissioner on his investigation of the question of transportation in the City of Vancouver and the surrounding districts in its findings and recommendations justifies the past policy and operations of the company, and is not only an answer to criticisms, but upholds the contentions of the directors and management in regard to the Jitney competition. Negotiations are now proceeding with a view to making arrangements for giving effect to the Commissioner's recommendations, and, pending the outcome of these negotiations, the directors are of opinion that it is not advisable to deal further with the situation arising out of the recent amendments to the Vancouver Incorporation Act explained in the statement issued to the stockholders in July last. A further statement will be issued to the stockholders as soon as the arrangements have been completed. For the first four months of the current year the gross earnings show an increase of approximately $146,81 This increase has, however, been more than absorbed by increased expenses due to higher wages and increased cost

materials, in consequence of which the net earnings for the period show an approximate decrease of $2,648. Having regard to the uncertain outlook for the immediate future, it is prudent to postpone the payment of the interim dividend payable January 15th, 1918, on the 5 per cent. cumulative perpetual preference stock. If, however, at the end of the financial year an improvement in the operating results is shown, the whole or part of the dividend may be distributed in July next, and a resolution giving authority to the directors to draw on the reserve fund so far as may be necessary for this purpose will be submitted to the annual meeting on January 4th.

British Coalite Co., Ltd.

Speaking at the annual meeting, the Chairman, Mr. W. J. FISHER, said that the future of British industry must be largely influenced by the price at which power on a large scale could be supplied in the form of electric current if, as a nation, they were to compete successfully in the manufacture of products which in the past had to a considerable extent been obtained from countries in which water power was available. The board had been anxiously considering how to provide for the rapid erection of Coalite plants all over the country, and had decided to arrange for the development of the process on a royalty basis with a financial group. An agreement of this nature had been made with Low Temperature Carbonisation, Ltd., which was creating an entirely new organisation with a view to future developments. Should this arrangement prove successful the quantity of coal carbonised by their process would greatly exceed 700,000 tons per annum. The ultimate result could not be doubtful. The report of the Coal Conservation Sub-Committee advocated the substitution of gas fuel in place of crude coal for the production of electrical energy. The proposal was to divide the country into districts, and create large generating stations whence electrical energy could be distributed. For the full attainment of this ideal the distillation of coal at low temperatures was indispensable, and this would materially strengthen the position of this and its allied companies.

Cordoba Light, Power and Traction Co., Ltd.

During the year there has been a deficiency in the supply of water from San Roque Lake, and in consequence over 25 per cent. of the energy required to supply the customers and tramways was generated by steam. At times it was necessary to curtail the supply of current to consumers, and in consequence of this and of a strike on the tramways in sympathy with the railway strike, the taking of the subsidiary companies were reduced by about £3,500, while the extra expenses due to steam operation alone were over £34,000, or £11,000 more than the previous year. As a result of the abnormal working expenses, says the *Financial Times*, the profits were not sufficient to meet all the charges, and the profit and loss account shows a loss of £17,721. This has been deducted from the amount brought forward, leaving a balance of £8,630, which the directors recommend be carried forward.

Sir G. A. TOUCHE, M.P., presided at the annual meeting on Monday. He said that perhaps no companies had been hit worse in the war than those operating abroad in countries where it was necessary to import fuel. Had there been anything approaching a normal rainfall they would have been, not altogether, but in a large measure, independent of the fuel problem, and of some of the worst trading results of the war. The effect of the drought would be understood when he mentioned that the expenditure on the operation of their steam plant, which was £985 in 1915, rose to £23,700 in 1916, and to £35,000 in 1917. It would be contrary to all experience to expect so great a failure of water three years in succession. If they could revert to a position where the hydraulic energy was nearly sufficient they might see a swift change in their fortunes. During the whole year the situation in Cordoba, and, indeed, in the Argentine generally, had been one of exceptional difficulty, but the results of the six months ended September 30th, 1917, had been considerably better. The gross receipts of the combined businesses had amounted to £158,806, compared with £162,460 in 1916, and £157,590 in 1915, and considering the difficulties of the year, such takings were not unsatisfactory. Their misfortunes, however, stood revealed in the growth of expenses. In 1915 they were £74,270, in 1916 £100,539, and in 1917 £111,532. The present position of affairs in the Argentine was rather more promising. They must not look for normal results while the war lasted, or for some time after, although they might hope for an amelioration of the conditions caused by the drought.

Venezuela Telephone & Electrical Appliances Co., Ltd.—Profit £18,237, plus £11,222 brought forward. After providing for debenture interest, &c., and £2,399 for excess profits duty, the directors propose a dividend of 8 per cent. on the preference shares, putting £6,000 to reserve for renewals and depreciation, and carrying forward £15,057 to undivided profits account. For the previous year 30 per cent. was paid on the preference shares, leaving arrears as from October 1st, 1910, while during the present year holders of the preference shares released their right to all arrears of dividend up to June 30th, 1916, in consideration of the transfer to them of certain shares in another company.—*Financial Times.*

Buenos Aires Port & City Tramways, Ltd.—The report for the period from June 18th, 1915, to June 30th last states that through the receiver statements of working in Buenos Aires have been received, and the accounts are based upon the figures so supplied. For the period of one year and 12 days to June 30th, 1916, the result, after allowing for certain charges by the receiver in Buenos Aires and London, showed a surplus of £9,335, and for the year ended June 30th, 1917, a surplus of £3,810. The total sum in respect of interest on the 6 per cent. debentures remaining unpaid amounted at June 30th, 1917, to £108,406. No scheme of reconstruction has yet been formulated by the receiver of the debenture holders, and, according to the *Financial Times*, the directors cannot hope that any effective steps can be taken for this purpose until after the termination of the war.

Companies Struck Off the Register.—The following have been struck off the register and are dissolved:—

Eastern Electric Co., Ltd.
Electrical Engineering & Motor Co. (Carlisle), Ltd.
Marine & General Oil Engines, Ltd.
Standard Bolt & Nut Co., Ltd.
Transport Development & Power Syndicate, Ltd.
X.L. Electric Co., Ltd.

Burmah Electric Tramways & Lighting Co., Ltd.—Profit for year to July 31st, £9,498. £3,000 is put to reserve for depreciation and £500 to reserve for depreciation of investments. Dividend, 6 per cent. on preference shares, against 5 per cent. for each of three preceding years (leaving arrears of 53 per cent.), and carrying forward £500.—*Financial Times.*

Humphrey Pump Co., Ltd.—War conditions have again adversely affected the company's business. The company has been engaged for some time on a general engineering contract for the Government. The profit and loss account shows a deficiency of £5,913, making the total deficiency £32,288.

Victoria Falls & Transvaal Power Co., Ltd.—Six months' dividend at the rate of 6 per cent. per annum, less income-tax, on the preference shares.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—Final dividend at rate of 6 per cent. on 6 per cent. cumulative preference shares.

Chile Telephone Co., Ltd.—Interim dividend, 3 per cent., tax free, on ordinary shares.

Coventry Chain Co., Ltd.—Dividend for the year on the ordinary shares 10 per cent., and a bonus of 5 per cent., less tax.

STOCKS AND SHARES.

NEW YEAR'S DAY, 1918.

BY far the most important event of the year of electricity finance befell at its very end, in the publication of the interim report by the Coal Conservation Sub-Committee on the Supply of Electric Power in Great Britain. "A haphazard multiplication of small generating plants situated not at points where generation can be effected most cheaply," is the sweeping description of present arrangements for electricity supply, with over 600 undertakings to deal with them; 70 separate generating stations in Greater London, working 49 different systems of generation. The Sub-Committee suggests 16 districts for Great Britain, with one authority in each district to deal with all the generation and main distribution, and it estimates that a saving of one hundred million pounds in cash and 55 million tons of coal could be effected under its proposals.

Such a huge scheme has been the dream of far-seeing electrical reformers for at least twenty years. Various efforts have been made to work it out on a modest scale, but slender success has met every attempt. What the scheme, if brought into practical politics, will mean to existing companies, nobody knows, and the Stock Exchange List of prices remains unchanged from beginning to end.

Substantial variations in prices have occurred, however, since the end of 1916. London lighting shares show a large preponderance of rises over falls; the Telegraph list is equally satisfactory to holders. Home Railway stocks have given way, and so have many of the issues in companies dealing with transport abroad. Manufacturing shares wind up the year well, and have useful rises to their credit. The British Insulated has divided its £5 shares into £1 shares, and, on the basis of the former, the price is 65s. to the good, while General Electrics are £6 up. Consideration of our usual comparative tables will leave a comforting effect upon those who feared, twelve months ago, that the third year of war would play havoc with the fortunes of companies engaged in electrical or allied work, and this experience may be of hopeful augury in regard to the New Year just beginning. We accordingly present the following selections from our regular weekly Lists of Stocks and Shares:—

HOME ELECTRICITY COMPANIES.

Ordinary Shares.	Dec. 29th, 1916.	Dec. 31st, 1917.	Rise or fall.	Ordinary Shares.	Dec. 29th, 1916.	Dec. 31st, 1917.	Rise or fall.
Brompton ..	6⅜	6¼	— ⅛	London Electric .	1⅛	1	— ⅛
Charing Cross ..	9¼	4	+ ¼	Metropolitan ..	2¼	3½	+ 1
Chelsea ..	0	2½	—	St. James' ..	6	7	+ 1
City of London ..	11⅜	13½	+ 1⅛	South London ..	2⅜	3	+ ⅛
County of London	10¼	11	+ ¼	Westminster ..	5⅛	6⅜	+ ⅛
Kensington ..	5⅜	5⅛	— ⅛				

TELEGRAPHS AND TELEPHONES.

Ordinary Shares.	Dec. 29th, 1916.	Dec. 31st, 1917.	Rise or fall.	Ordinary Shares.	Dec. 29th, 1916.	Dec. 31st, 1917.	Rise or fall.
Ang.-Am. Pref.	93½	95½	—	Indo-European ..	49½	52½	+ 3
Cuba Submarine	8½	9½	+ 1	Marconi	2⅞	3⅛	+ ¼
E. Extension ..	14	15	+ 1	Oriental Telep. ..	2⅞	3	+ ⅛
E. Telegraph	140½	150½	+10	United R. Plate..	6⅛	6⅜	+ ¼
Globe Tel.& Trust	12⅝	13⅞	+ 1¼	W. India & Pan.	1	1⅛	+ ⅛
Great Northern ..	87	86	— 1	Western Teleg. ..	13⅝	15½	+ 1⅞

HOME RAILS.

Cen. London Ord.				Under. Elec Ord.	2⅛	1⅞	— ¼
Assented ..	65½	60½	— 5	do. do. "A"	6/6	5/-	— 1/6
Metropolitan ..	25	22½	— 2½	do. do. Inc..	92½	81	—11½
Met. District ..	16½	16	— ½				

FOREIGN TRAMWAYS, &c.

Anglo-Arg. Trams.				B. Col. Elec. Def.	35½	28	— 7½
First Pref. ..	3	2¾	— ¼	Mexico Trams 5 %	32½	27½	— 5
Brazil Tractions	49	45	— 4	M'x'can L'g't Com	7⅞	17⅞	+10
B. Col. Elec. Prfce	63½	42½	—20	do. Pref. ..	15½	29	+13½
do. do. P'ferrd	40½	30	—10½	do. 1st Bonds	27½	33½	+ 5

MANUFACTURING COMPANIES.

Babcock & Wilcox	2 13/16	3⅛	+ 5/16	Edison Swan (f. p.)	1⅞	2⅛	+ ¼
Brit. Aluminium..	1⅛	1 3/16	+ 1/16	Elec. Construction	1 3/16	1⅛	+ 1/16
Brit. Insulated ..	11½	8	+ 3½	Gen. Elec. Ord. ..	13½	19½	+ 6
B. West. Pref. ..	2⅜	2 11/16	+ 5/16	Henleys	16	16½	+ ½
Callenders	13	14½	+ 1½	India-Rubber ..	13½	14½	+ 1
Castner-Kellner ..	3 3/16	3 13/16	— 3/16	Telegraph Con. ..	38	41½	+ 3½

In these days of paper shortage, when many clients will, perforce, miss the receipt of the customary Stock Exchange Official List from their stockbrokers, we hope that the above catalogues of quotations may prove of more than ordinary use, but this hope is subsidiary and insignificant compared with the cordial wish of a more happy and prosperous New Year to the patient followers of these notes.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Dec. 31, 1917.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	9	6½	—	£6 18 6
Charing Cross Ordinary ..	5	5	4	—	6 5 0
do. do. do. 4½ Pref..	4½	4½	3⅝	—	6 18 4
Chelsea	4	3	2½	—	5 9 1
City of London	8	8	13½	—	6 0 9
do. do. 6 per cent. Pref.	6	6	10⅝	—	5 18 6
County of London	7	7	11	—	6 7 8
do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	7	6	9⅝	—	5 11 7
London Electric	3	Nil	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8½	—	5 6 8
Metropolitan	8	8	9½	—	4 12 4
do. 4½ per cent. Pref.	4½	4½	3⅝	—	6 13 4
St. James' and Pall Mall ..	6	6	7	—	5 14 6
South London	5	5	3	—	6 13 4
South Metropolitan Pref. ..	7	7	21/6	—	6 10 6
Westminster Ordinary	7	7	8⅜	—	6 9 8

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	85½	— ½	6 5 6
do. Def.	33/8	1½	2⅜	—	6 8 4
Chile Telephone	8	8	7½	—	5 11 4
Cuba Sub. Ord.	6	7	9½	—	*7 11 4
Eastern Extension	8	8	15	—	*5 6 8
Eastern Tel. Ord.	8	8	15½	—	*5 6 4
Globe Tel. and T. Ord.	7	7	13½	—	*5 1 10
do. Pref. ..	6	6	10⅜	—	5 17 1
Great Northern Tel.	22	24	36	—	6 11 6
Indo-European	18	18	59½	—	6 3 10
Marconi	10	15	3⅜	+ 7/16	4 14 9
Oriental Telephone Ord. ..	10	10	8	—	6 6 8
United R. Plate Tel.	8	8	6⅛	—	*5 17 6
West India and Pan	6d.	6d.	1/16	—	*3 9 6
Western Telegraph	7	8	16½	—	*5 5 0

HOME RAILS.

Central London, Ord. Assented	4	4	60½	—	6 12 8
Metropolitan	1	1	22½	+ ½	4 10 0
do. District	Nil	Nil	16	+ ⅛	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A" ..	Nil	Nil	5/-	—	Nil
do. do. Income	6	4	81	—	*4 18 9

FOREIGN TRAMS, &c.

	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	6½	2½	— ¼	—
do. 2nd Pref. ..	5½	—	2½	—	—
do. 5 Deb. ..	5	5	65½	—1	7 11 8
Brazil Tractions	4	4	45	— ½	—
Bombay Electric Pref.	6	6	9⅜	—	6 4 9
British Columbia Elec. Rly. Prfce.	5	5	4⅜	—	11 15 4
do. do. Preferred	Nil	Nil	30	—	Nil
do. do. Deferred	Nil	Nil	28	—	Nil
do. do. Deb.	4½	4½	56	—	7 11 9
Mexico Trams 5 per cent. Bonds	Nil	Nil	27½	—5	Nil
do. 6 per cent. Bonds	Nil	Nil	27⅜	—5	Nil
Mexican Light Common ..	Nil	Nil	17⅜	—	Nil
do. Pref.	Nil	Nil	29	—	Nil
do. 1st Bonds ..	Nil	Nil	33½	—	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	8½	+ 1/16	4 12 6
British Aluminium Ord. ..	7	10	1⅜	—	9 5 9
British Insulated Ord. ..	17½	20	4	—	6 13 4
British Westinghouse Pref. ..	7/8	7/8	2½	—	5 11 4
Callenders	30	30	14½	—	6 18 0
do. 6 Pref.	6	6	xxd	—	5 5 9
Castner-Kellner	22	20	3⅝xd	—	5 17 8
Edison Swan, fully paid ..	—	—	2⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	75½xd	+1½	5 6 0
Electric Construction	7/8	7/8	1⅛	—	6 13 4
Gen. Elec. Pref.	9	9	10½	— ¼	5 17 3
do. Ord.	10	10	19½	—	5 1 3
Henley	25	25	16½	—	7 11 6
do. 4½ Pref.	4½	4½	4	—	5 12 2
India-Rubber	10	10	14½xd	—	*6 18 9
Telegraph Con.	30	30	41½	—	*5 16 —

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, January 2nd.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£76	..
a Ammonia, Muriate (large crystal)	,,	£58	..
a Bisulphide of Carbon	,,	£28	..
a Borax	,,	£38	..
a Copper Sulphate	,,	£67 10/-	30/- inc.
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	£18	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers ..	,,	£35	..
a ,, Lump	,,	£24	..
a Soda, Chlorate	per lb.	10½d.	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks ..	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn) ..	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn) ..	,,	1/6½ to 1/7½	..
g ,, Bars (best selected) ..	per ton	£147	..
g ,, Sheet	,,	£147	..
g ,, Rod	,,	£147	..
d ,, (Electrolytic) Bars ..	,,	£125	..
d ,, ,, Sheets ..	,,	£152	..
d ,, ,, Wire Rods ..	,,	£133	..
d ,, ,, H.C. Wire	per lb.	1/8½	..
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	2/10	4½d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£42	..
g Lead, English Pig	,,	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small ..	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large ..	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/6½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	4/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Factory Act Prosecution.—At the Hayward's Heath Petty Sessions, on December 31st, the Burgess Hill District Electric Supply Co. were summoned for two infringements of the Factory and Workshops Act, by employing a young person after prohibited hours on November 17th and 18th. It appeared from the evidence that Frederick Goldsmith, aged 17 years, worked for the company on November 17th, starting work at 9.30 or 10 a.m., and leaving at 1 p.m.; he returned between 3.30 and 4 p.m., and went on till 10 p.m. On November 18th he started at 3.30, and worked until 10.30 p.m. For the defendants, it was stated that the company was a small concern, and it was unfortunate for them that those cases had arisen, but it was all in consequence of the depletion of labour owing to the war, and the necessity to fill the ranks of the Army. The company before the war had four men working in day and night shifts in the engine room, and only one of these was now in the employ of the company. Mr. Prior, the manager, was now left with only a man and a boy to run the machinery. They had tried their very best to replace the men, but could not until lately, when they secured a discharged soldier. The electric light at Burgess Hill was a public necessity, and had to be kept going at all hazards. It was urged that there were grounds for mitigation of any penalty which might be imposed owing to the great trouble the company had had to fill up the vacancies on the staff at the works.

Mr. Edward Prior, the manager, said that before the war he had four able-bodied men in the engine room. Three had joined up. He could not get other men, and took Goldsmith on in their place. He had now taken on a discharged soldier. He had been working under great difficulties, and would be glad to fill up his staff. They had to shut down the works at 10.30. The lad Goldsmith was taken on in place of a man, and they expected him to work the same hours as a man. There was not so much current used in war time owing to the restrictions on lighting. The Chairman said the Magistrates took into consideration the great difficulty there was in obtaining labour, also that the electric works were of public utility. There must, however, be a conviction. Defendants would be fined 10s. in each case, and 1s. 3d. costs would be allowed in each case.

A Municipal Industrial Council.—London boroughs are being asked to set up a joint Industrial Council, representing the City Corporation and the City and Metropolitan Councils, and their workmen, to deal with differences as to wages and conditions of employment.—*Daily Chronicle.*

HIGH-EFFICIENCY AIR PUMPS FOR HIGH VACUA.

BY E. JONES.

(*Abstract of paper read before the* LIVERPOOL ENGINEERING SOCIETY, *December 5th*, 1917.)

CLAIMING that the "multijector" air-pump has come to stay, and will challenge the supremacy of the reciprocating and rotary types, the author gives a detailed description of the Leblanc steam-operated ejector air pump in its present form. Fig. 1 is a sectional drawing of the complete apparatus. Steam is admitted into a receiving box through a strainer fitted with brass wire gauze of 40 to 60 mesh in two coils,

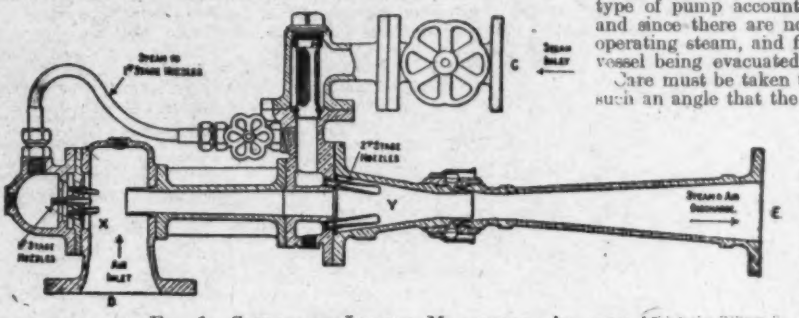

FIG. 1.—SECTION OF LEBLANC MULTIJECTOR AIR-PUMP.

arranged to be staggered so that it is almost impossible for foreign matter to pass through. The first stage nozzle plate is fitted with a ring of nozzles directed at a particular angle towards the axis; the nozzles are made to a high degree of accuracy, and are locked in position by a copper locking plate. The steam from the first-stage nozzles, with the air entrained, passes into the first-stage diffuser, the bore of which is accurately machined to provide for the proper compression of the air. The second-stage steam receiving box has a central core forming a continuation of the first-stage diffuser, with an outer annular space to permit the steam to feed the second-stage nozzles, and is provided with a strainer similar to that on the first-stage box. The nozzles in the second stage are more numerous and of larger size than in the first stage, and discharge into a mixing chamber which opens into a diffuser, whence the steam and air pass to the outlet. The whole of the apparatus is constructed of gun-metal; there are no intricate castings, and the parts are light and easily machined.

The weight of air dealt with depends upon the weight of steam used, and the minimum steam pressure adopted in practice is 80 lb. per sq. in. (gauge), though ejectors can be designed for lower pressures. The air is entrained by friction, and the amount that can be entrained depends on the kinetic energy of the steam. Given the operating steam pressure and the quantity of steam to be used or the weight of air to be extracted, the necessary calculations, of which examples are given in the paper, present no difficulty, ample data being available for the use of the designer. The angle of taper for all the steam nozzles used in these pumps is six degrees, and for the diffusers from 3 to 10 degrees, being determined in the latter case by experiment.

In the case of the ejector here illustrated, the total quantity of steam used equals 865.4 lb. per hour. The net heat expenditure in the pump equals 35,277 B.TH.U. This pump would deal with 33, 48, 60, and 80 lb. of air per hour at 95, 93, 91, and 88 per cent. of the theoretical vacuum respectively.

The calculations relating to steam nozzles are exactly in accordance with well-known and established laws, and similar to calculations used in the design of turbine nozzles. It is seldom required to make any changes on these nozzles when testing an ejector. The design of the diffuser is a more complex question than that of the steam nozzle. In the diffuser both steam and air are being dealt with, flowing at different velocities and in a state of aggregation varying at each instant. It is essential to have the steam nozzles machined accurately; if this is not done the amount of operating steam will exceed the calculated figure, and the overall efficiency of the pump will suffer. The high velocities engendered in this type of pump account for the small bulk of the apparatus; and since there are no moving parts, high velocities of the operating steam, and fluid drawn from the condenser or other vessel being evacuated, are not objectionable.

Care must be taken to fix the nozzles in the nozzle plate at such an angle that the steam is directed well into the diffuser, and that the nozzles are placed at a proper distance from the throat of the diffuser. The latter has an important effect on the air-dealing capacity of the apparatus. If it is desired to deal with a large quantity of air at a comparatively low vacuum, it will be found that by placing the nozzles farther away from the diffuser the pump will deal with a greater quantity of air than if they are placed close up to the diffuser entrance.

No useful purpose is served by supplying an ejector with superheated steam. Nevertheless, wet steam is not good for the efficient working of the ejector, and a small amount of superheat is always preferred.

In order to obtain the best results, the heat contained in the steam and air leaving the pump must be utilised, and the common practice is to use it to heat the boiler feed water. If due care is paid to the recuperation of this heat energy, it will be difficult to find a more efficient air-pump.

Certain slots, or holes, are placed on the second-stage diffuser and communicate with the atmosphere. If the ejector is working at a low vacuum and dealing with a large quantity of air, these holes are unnecessary; but if a high vacuum is desired, and the quantity of air being dealt with is small, such connections serve a useful purpose by admitting a certain volume of air from the atmosphere to fill the space in the diffuser, and thus prevent the formation of eddies which would occur were the holes not there. The amount of air thus admitted, if any, is automatically regulated by the space available in the diffuser, and does not require a valve of any kind.

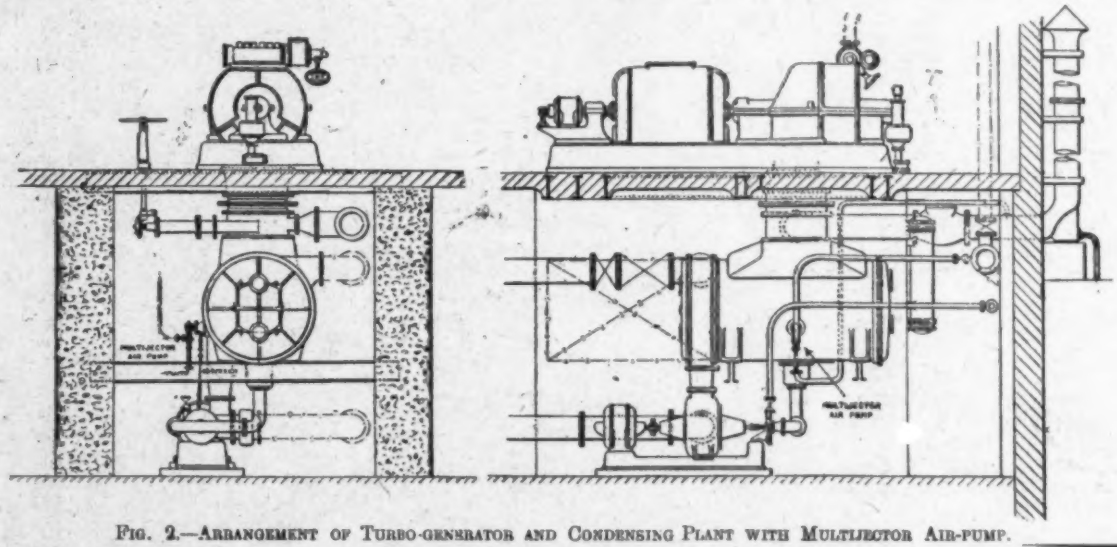

FIG. 2.—ARRANGEMENT OF TURBO-GENERATOR AND CONDENSING PLANT WITH MULTIJECTOR AIR-PUMP.

The apparatus illustrated in fig. 1 represents a complete Mirrlees-Leblanc multijector dry air pump. In an ideal installation the work involved in putting the plant into commission is a minimum, as it would only be necessary to make three ordinary pipe joints—one connecting the pump to the vessel to be evacuated, one to the steam supply pipe, and a third to the discharge pipe. Such installations are, however, exceptional. The pump can be placed in any convenient position, which is never a difficult proposition when the small space required is taken into consideration.

The discharge from the pump should, if possible, be led to

a feed heater arranged to allow the air contained in the discharge to escape to the atmosphere, while the condensed steam drains away to the feed tank, where it can be utilised as a make-up supply for the boilers.

If the operating steam supply is at very high pressure, or liable to variation, it is advisable to use a reducing valve on the steam inlet pipe range, designed in such a manner as to maintain a constant pressure on the ejector side of the valve.

The steam strainers should occasionally be taken out and cleaned with paraffin, or other agent, and it is advisable to keep a spare strainer cleaned and ready to be put in at any time. As the pump can be overhauled and put together again in three or four hours, and as there are no moving parts whatsoever, the working expenses are practically nil. There is nothing on the pump that can wear out and require replacing.

Two installations are at work in the Greenock Corporation electricity department, in conjunction with two 5,000-KW. Westinghouse turbo-alternators. They are able to obtain the maximum vacuum and go on to full load in five minutes.

The chief application of this apparatus is in conjunction with the various types of condensing plant, and up to the present time the number of installations fitted, or under construction, represents about 500,000 KW., or, expressed in pounds of steam condensed per hour, equals 9,000,000 lb. approximately.

Generally in all surface condensers for modern requirements a high degree of vacuum is necessary, and a comparatively small quantity of air has to be dealt with, which makes it possible to use an ejector absorbing only a small amount of heat, thus adding considerably to the overall efficiency of the plant. For jet barometric and evaporative condensers the same high degree of vacuum can be maintained, but naturally the air-dealing capacity for the same steam duty as a surface condenser has to be increased to deal with the extra quantity of air brought into the system with the injection water in jet and barometric condensers, and at the joints in evaporative condensers. In order to reduce the size to a minimum, an intercooler is sometimes used, and by this means the temperature, and consequently the volume of the air, is rendered as low as possible.

There are numerous existing installations working with inefficient air pumps and low vacua where it would be a very easy matter to install a multijector and effect a considerable saving in the annual coal bill. Whether this would be done best by scrapping the old pumps altogether or fitting a small ejector to act as a vacuum augmentor would depend entirely on the prevailing conditions, and each particular case would require special investigation.

Fig. 2 shows diagrammatically a typical condenser installation fitted with multijector air pumps for a surface plant for land service.

THE APPLICATION OF ELECTRICITY TO VARIOUS AUXILIARIES ON SHIPBOARD.

THE following is an abstract of a paper by Mr. H. L. HIBBARD read before the SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS, New York:—

The marine engineer and the seafaring man in general are naturally conservative in the adoption of new and untried apparatus. The time is rapidly approaching, however, if not already here, when the results obtained will justify the construction generally of vessels electrically equipped in all or many of their power applications.

Two or three years ago, the *Christian X* created much interest on its first voyage with its oil-propelled engines and electrically-operated auxiliaries. The *Chile*, constructed by Burmeister & Wain, of 13,400 tons displacement, and provided with oil engines of 3,000 H.P., was equipped throughout with electrically-operated auxiliaries, both for engine-room and deck machinery. Three Diesel engine-driven, 60-KW. generators furnished direct current to the auxiliaries at 220 volts; one of these sets was sufficient to supply auxiliary power while at sea, and two were used while handling cargo in port. At least one generating set was, therefore, always available as spare.

In the engine-room equipment were included motor-operated fans, a motor-driven centrifugal, circulating water pumps, bilge and sanitary pumps, ballast pumps, engine-turning motor, motor for operating tools in repair shop, &c. In the deck equipment, electrically-operated steering gear, deck winches, and anchor windlass were provided.

As far as we have been able to ascertain, the result of the operation of these equipments has been in every way satisfactory on this vessel, and an interesting article as to the general performance of the vessel was contained in the February issue of *Motorship*. In a visit to this vessel the writer noted the construction and distribution of the electrical equipment, and although it was perhaps somewhat clumsy in design, the engineers in charge appeared well pleased with its performance, and had encountered no particular difficulties.

An article appearing in the March issue of *Motorship* by Mr. G. E. Smith, chief engineer of the American Engineering Co., reviews this situation, and makes the significant remark that "the writer is firmly of the opinion that within a very short time all auxiliaries on motor ships will be electrically driven."

At last year's meeting of the Society, a paper by Mr. Frear was presented, covering a description and results obtained from the oil tanker *La Brea*, which was apparently the first instance of electrically-operated cargo pumps on a tank ship, and, as indicated in Mr. Frear's paper, the results were very gratifying, particularly when compared to her sister ship, the *Los Angeles*, equipped with reciprocating engines and steam pumps in contrast with the geared steam turbine and electrical pumps on the *La Brea*.

Among the most striking examples of the use of electricity on merchant vessels are the boats being constructed and projected by the Pennsylvania Shipbuilding Co., New Jersey. This company has under construction six tank steamers of about 7,500 tons displacement, which will be propelled by geared steam turbines, and their auxiliaries operated by electricity throughout. The electrical equipment on each of these vessels will consist of the following:—

Two 100-KW., 3-phase, 60-cycle, 220-volt steam turbo-generating sets; one anchor windlass, 25-H.P. slip-ring type motor; one forced draught fan, 25-H.P. slip-ring type motor; one steering gear equipment, 15-H.P. squirrel-cage type motor; two cargo oil pumps, 80-H.P. squirrel-cage motors, 3-speed, pole changing; two deck winches, 15-H.P. squirrel-cage type motors; one warping winch, 15-H.P. squirrel-cage type motor; one oil transfer pump, 5-H.P. squirrel-cage type motor; one forward bilge pump, 5-H.P. squirrel-cage type motor; one bilge pump for pump room, 5-H.P. squirrel-cage type motor; one circulating water pump, 5-H.P. squirrel-cage type motor; one workshop motor, 5-H.P. squirrel-cage type; one refrigerating plant, 5-H.P. squirrel-cage type motor; one oil tank ventilation blower, 5-H.P. squirrel-cage type motor; one fresh water pump, 5-H.P. squirrel-cage type motor.

In addition to the above tankers, two cargo vessels of 12,000 tons displacement will soon be laid down, each of which will have an equipment of auxiliary motors similar to the above tank vessels with the exception of the deck winches, which will consist of three of 25 H.P. and eight of 15 H.P. It is further contemplated that these two cargo vessels will be electrically propelled and operated by two turbo-generating sets, each set furnishing current to a 1,500-H.P. motor, the two motors being geared to the single propeller shaft.

In addition to these vessels, this company contemplates the construction also of six cargo boats propelled by geared steam turbines, and with electrical auxiliaries similar to the above.

For the above vessels open-type alternating current motors will be provided throughout, and watertight enclosing cases furnished for the deck motors, with the particular view of protecting them from exposure to moisture; but the cases can be removed, if desired, when the vessels are in port, to give the motors ample ventilation.

The majority of the motors will be operated from a common switchboard in the generator room, and in most cases no means is provided for starting or stopping the motors at the auxiliary. A particular exception is the case of the anchor windlass, which has its controller near the motor on deck.

It will be noted that alternating current has been employed throughout on the above vessels, and those advocating the same point to the necessity, in the case of the tank vessels, of using the alternating current squirrel-cage type motor, with its freedom from moving contacts in places exposed to the possible presence of oil vapour. With the same object, the controlling devices, as described above, are all centralised in the generator room. On these vessels also an interesting form of deck winch is used for the first time, employing a constant running motor and a set of planetary gears, so arranged that, by the operation of a lever and two brake bands, the load can be stopped or the speed of the winch varied while the motor continues to operate at constant speed.

In contrast to the alternating current used on the above vessels, the Texas Oil Co. is soon to construct a tank vessel of approximately 6,000 tons displacement, propelled by fuel-oil engines, and provided with direct-current, 230-volt motors on its auxiliaries. The principal auxiliary equipments on this vessel will be as follows, although a few additional items will probably be eventually supplied:—

Six 30-H.P. variable speed cargo pump motors, enclosed type, variable speed; one 20-H.P. fire-room bilge pump motor, enclosed type, constant speed; four 5-H.P. constant speed enclosed type motors for operating auxiliary pumps; two refrigerating machines, 3-H.P. enclosed type motors, variable speed; one 10-H.P. steering gear motor, open type, constant speed; two cargo deck winches, 20-H.P. enclosed type, compound wound; one 20-H.P. capstan, open type, compound wound; one 25-H.P. windlass, enclosed type, compound wound.

The six cargo pump motors and the bilge pump motor, all we understand located in the same compartment, will be operated from controllers on a common switchboard in the generator room, similar to the arrangement for the Pennsylvania Shipbuilding Co.'s tankers. In addition, however, watertight push-button stations will be located adjacent to the motors, which will stop the pumps when desired, to be again started from the generator room. The cargo pump motors and the motors exposed on deck will be probably provided with enclosing cases, furnished with forced ventilation, or this forced ventilation will be carried directly into the enclosed motor frames.

In addition to the two cargo vessels at the Pennsylvania Shipbuilding Co.'s plant, which it is intended to propel electrically, we are familiar with electrical installations on four

oil barges under construction at New Orleans by the Petroleum Transport Co. These boats are twin screw, each propeller being driven by a 300-H.P., 480-volt, 3-phase, 60-cycle motor, the two motors being operated by one turbo-generating set of similar voltage and frequency. These motors are operated by automatic contactor controllers from a common master station, two control levers giving straight-line motion similar to the valve levers of the usual reciprocating engine installation.

While the geared steam turbine has shown some excellent results and the use of the heavy oil engine for propulsion purposes will probably be extended, a combination which may receive a good deal of consideration in the future in this connection, especially for equipments of average size, is the operation of one or two generating sets by oil engines instead of steam turbines, the generators to operate the propelling motors as at present. Such an arrangement provides the advantages of the use of fuel oil, at the same time retaining the flexibility of the electrical drive and permitting oil engines to be used without reversing features.

The progress made is noteworthy, especially in view of the opposition which has been encountered by the use of electricity until recently from many of the steamship companies, shipyards, and manufacturers of steam apparatus.

Numerous specific advantages are apparent in connection with such installations in the merchant marine, including frequently a saving in space and weight in the installation of the auxiliaries themselves, a very much higher efficiency of operation, and consequent saving in total fuel consumption, the elimination of long and objectionable lines of steam piping, which on certain classes of cargo vessels are nearly always installed above deck, and result in continual steam condensation; also, on certain of the auxiliaries, particularly those requiring varying speed and load conditions, the electric motor offers some distinct advantages over the use of the steam engine.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

B.T.H. Vertical-Spindle Induction Motors.

We have recently received from the BRITISH THOMSON-HOUSTON CO., LTD., Rugby, list No. 2,180 of vertical-spindle induction motors, these machines being specially built for vertical direct connected driving where two or three-phase A.C. is available.

These vertical induction motors are supplied in all sizes from 2½ to 450 H.P., and consist of a stator suitably designed for the speed and supply circuit, and a rotor of either squirrel-cage or slip-ring type.

The latter type of machine has its advantages in starting under load with reasonable current, and permits of speed variation by the insertion of resistance in the rotor circuit.

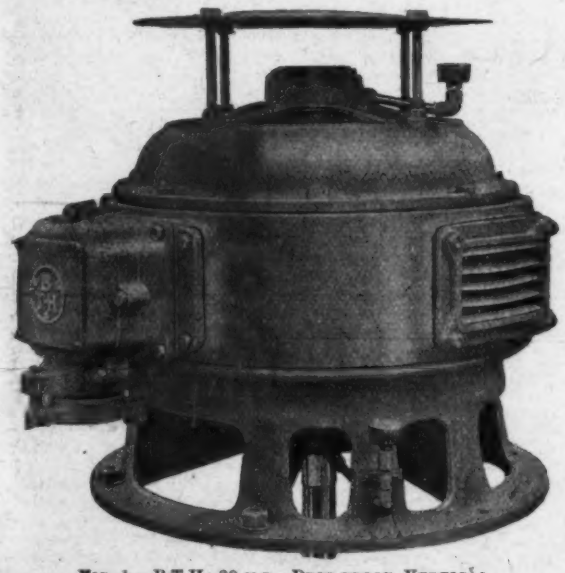

FIG. 1.—B.T.H. 30-H.P., DRIP-PROOF VERTICAL INDUCTION MOTOR.

The squirrel-cage motor, on account of its simplicity and absolutely sparkless operation, is specially suited to certain industries and situations, especially where a possibly heavy starting current is not open to objection. On account of the latter feature it is generally used for small powers, but a starting device can be used to prevent the rush of current at starting, at the expense, however, of the starting torque.

Standard machines for two or three-phase, 40, 50, or 60-cycle circuits, are supplied for pressures between 95 and 550 volts. These machines are rated at 40° C. temperature rise under continuous full-load conditions, and embody the well-known features of B.T.H. construction; they are reversible by interchanging the stator leads, and the three-phase machines can be supplied with three or six terminals, the latter for use with star-delta starters, while the two-phase machines similarly can be provided with four or eight terminals, the latter for use with series-parallel starters.

Full particulars are given of H.P., speed, type, &c., of all these motors.

A Method of Banding an Armature.

The accompanying illustration shows a method of banding armatures that does away with the old scheme of using two pieces of fibre as a clamp or twisting the band of wire around a nail to draw it tight enough, which necessitates the completion of a band when once started, and further obviates the removal of a band should it not be sufficiently tight. It will also be found that should the coils project above the core in the banding space, they can be gradually pressed down without driving with a hammer and fibre wedge, thus eliminating one of the frequent causes of short-circuits when the coils are very tight.

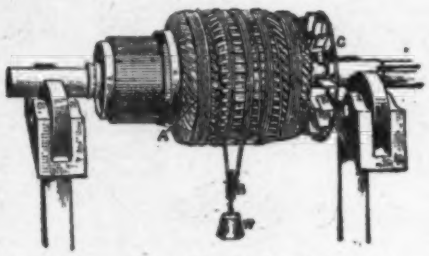

FIG. 2.—BANDING AN ARMATURE.

To use this method, fasten one end of the banding wire to a coil at one end of the winding at A, and lay the band on hand tight in one piece; then pass the finishing end of the banding wire through the pulley B, and fasten it to the winding at the other end of the armature, as shown at C. Attach a weight W to the pulley, according to how tight the band is required, and turn the armature. When the armature is turned, no matter how fast, the banding wire will follow in exactly the same place as it was laid by hand, consequently the band must be placed on in the first place perfectly straight. When the weight has travelled to the other end of the armature, if the bands are not satisfactory, turn the armature in the opposite direction, and keep on repeating the operation until tight enough.

This may be repeated as many times as deemed necessary, and more weight may be added as the process is continued, until sufficient pressure is obtained without breaking the banding wire. On account of being thus able to apply a gradual pressure, the coils can be gradually pressed down into the slot, should they be high, with probably the assistance of a very light tapping with hammer and fibre.—R. THISTLEWHITE, in the *Mechanical World*.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Dust Coal.

One of the permanent troubles of the housekeeper is the want of a satisfactory way of burning the dust coal which accumulates in every coal cellar and, in spite of all efforts, invariably increases.

With fuel at its present prices, and stock limited, the matter has become of importance, and it should be worth while to systematically collect it, and, by converting it into briquettes of suitable size, secure its economical consumption.

I have long thought that every coal bunker of importance should be supplied with a small form of briquetting machine, while in many parts of the country such a machine could possibly travel from house to house in much the same way as in France the cider press is moved from house to house of small towns and villages, often operating in the street itself.

I make the suggestion in the hope that it may be possible to devise some such machine at no great cost, and am certain that its use would be advantageous to both the householder and the country generally. There are probably thousands of tons of dust coal in cellars practically wasted.

Perhaps, though, your readers may be able to suggest a new and satisfactory method of burning it without recourse to any such machine. I have tried various ways, and have not found a practical one.

Chile.

December 21st, 1917.

Re Mr. F. L. Rawson.

We understand that a number of people are under the impression that the above is connected with this company, in consequence of a statement made by him at a recent meeting of the I.E.E. referring to his office as "Consulting Engineer to the St. Helens Co."

Will you kindly allow us to clear our name from such a misunderstanding by stating that Mr. Rawson has never had any connection with this company.

We have investigated the matter, and find that the company to which Mr. Rawson referred is one using "St. Helens" as part of its name, and that it claims to obtain gold from sea water.

St. Helens Cable and Rubber Co., Ltd.

H. T. BROOKING, *General Manager.*

Warrington, *December 28th*, 1917.

Distinctive Colours for Braided Cables.

Referring to Mr. T. D. Spark's letter on the above subject, in the ELECTRICAL REVIEW of the 28th inst., it has been our custom for many years to supply cables having an outside compounding of a third colour, in addition to red and black, where desired. The most convenient colour, and the one which is usually adopted, is white, but other colours, amongst them yellow, could be supplied without difficulty.

W. T. Henley's Telegraph Works Co., Ltd.

J. BISHOP, *Manager, Sales Department.*

London, E.C., *December 31st*, 1917.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electric Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

18,704. "Sparking plug." E. LAX. December 17th.
18,729. "Electric petrol or fluid gauge." J. GOODLEY. December 17th.
18,731. "Means for cooling commutators of electrical machines." E. C. R. MARKS. (Akt. Ges. Brown, Boveri et Cie.) December 17th.
18,745. "Control mechanism for electrically-propelled vehicles." INDUSTRIAL APPLIANCES, LTD., & J. G. ROBINSON. December 17th.
18,746. "Controllers for motors of electrically-propelled vehicles." INDUSTRIAL APPLIANCES, LTD., & J. G. ROBINSON. December 17th.
18,748. "Machine switching telephone systems." L. POLINKOWSKY AND WESTERN ELECTRIC CO. December 17th.
18,750. "Sparking plugs." J. COURTIER & P. COURTIER. (France, July 12th.) December 17th.
18,753. "Dynamo-electric machines." M. LATOUR. December 17th.
18,763. "Means for utilising waste heat in electrical machinery, &c." H. F. J. THOMPSON & T. H. WOOD. December 18th.
18,778. "Electric arc lamps." H. S. A. RYDBERG. December 18th. (Sweden, November 11th, 1916.)
18,789. "Systems of electric cut-outs." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) December 18th.
18,796. "Automatic telephone systems." AUTOMATIC ELECTRIC CO. AND AUTOMATIC TELEPHONE MANUFACTURING CO. December 18th.
18,800. "Electrolytic processes." E. A. CUNNINGHAM. December 20th.
18,816. "Means of illuminating magnetic compasses, &c." C. F. RYLAND. December 19th.
18,847. "Cradle for supporting electric cables and their fittings." H. BLADES. December 19th.
18,860 & 18,861. "Rotary field magnets." B. LJUNGSTROM & F. LJUNGSTROM. December 19th. (Sweden December 19th, 1916.)
18,876. "Electric arc furnaces." H. COATES & WATFORD ELECTRIC AND MANUFACTURING CO. December 19th.
18,881. "Magnetic liquid compasses." M. B. FIELD. December 20th.
18,890. "Telephone writing tablet or pad-holder." C. W. H. WESTELL. December 20th.
18,900. "Electrolytic processes." CHANCE & HUNT, O. E. MOTT & T. A. SMITH. December 20th.
18,920. "Audion or lamp-relay or amplifying apparatus." M. LATOUR. December 20th. (France, December 20th, 1916.)
18,923. "Automatic switch for wind-driven electric supply plant." W. P. PERRY. December 21st.
18,935. "Magnetic blow-out fuses." G. H. NEEP AND SWITCHGEAR AND COWANS, LTD. December 21st.
18,953. "Electromagnetic clutches." A. SOAMES & W. LANGDON-DAVIES. December 21st.
18,954. "Insulated electric cables, wires, &c." CALLENDER'S CABLE AND CONSTRUCTION CO., P. M. BENNETT & J. F. WATSON. December 21st.
18,963. "Dynamo-electric machines, &c." J. F. POYNTER. December 21st.
18,976. "Apparatus for transmitting and distributing electrical energy." G. E. TURNBULL & A. V. L. HUBERT. December 21st.
18,993. "Spring drive for magnetos, &c." G. E. BRADSHAW & A.B.C. MOTORS, LTD. December 22nd.
18,995. "Sparking plugs." G E. BRADSHAW. December 22nd.
19,004. "Trolley guide for electric trams." W. BARRATT. December 22nd.
19,011. "Electrical steering of vessels." J. H. BALCOMBE & T. DAWSON. December 22nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

7,906. PORTABLE ELECTRIC BATTERY. A. Sandrini. June 5th, 1915. (100,643.)
12,168. INSULATION OF ELECTRIC CABLES. H. Tietgen. August 28th, 1916. (111,406.)
12,305. APPARATUS FOR CONVERTING OR TRANSFORMING ELECTRIC CURRENTS. K. T. Wang August 30th, 1916. (111,407.)
15,137. ELECTROLYTIC CELLS. F. G. Wheeler. October 30th, 1915. (102,049.)
17,170. HIGH-FREQUENCY SIGNALLING, PARTICULARLY APPLICABLE TO WIRELESS TELEPHONY. Western Electric Co. December 1st, 1915. (102,503.)
17,213. RECORDING APPARATUS. D. B. Morison. November 30th, 1916. (111,531.)
17,453. BOOSTING IN ELECTRIC DISTRIBUTING SYSTEMS. H. A. Gill. (U.S. Light & Heat Corporation.) December 5th, 1916. (111,543.)
17,454. DYNAMO-ELECTRIC MACHINES. H. A. Gill. (U.S. Light & Heat Corporation.) December 5th, 1916. (111,544.)
17,681. DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co., U.S.A.) December 8th, 1916. (111,551.)
17,702. ELECTRIC OVENS, HOT CUPBOARDS, AND THE LIKE. J. S. Langford. January 14th, 1916. (103,476.)
17,839. ELECTROMAGNET FOR LIFTING MATERIALS. A. D. Riviere and Soc. Centrale d'Enterprises A. D. Riviere et Cie. December 11th, 1916. (111,554.)
17,872. ROTARY DISTRIBUTORS, PARTICULARLY FOR USE IN THE IGNITION OF INTERNAL-COMBUSTION ENGINES. Etablissements de Dion-Bouton Soc. Anon. January 26th, 1916. (103,817.)
18,323. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. Westinghouse Metal Filament Lamp Co. (Westinghouse Lamp Co., U.S.A.) December 21st, 1916. (111,569.)
18,398. X-RAY APPARATUS. G. R. Hogan & H. P. MacLagan. December 22nd, 1916. (111,570.)

1917.

255. PROCESS OF ELECTRIC WELDING. T. E. Murray. February 18th, 1917. (104,500.)
1,307. STRIP-PERFORATING MECHANISM FOR CODE TELEGRAPHY. H. H. Harrison and Creed & Co. January 25th, 1917. (111,582.)
1,880. SPARK PLUGS. C. F. Arnold. February 7th, 1917. (104,334.)
3,606. AUTOMATIC SIGNALS FOR RAILWAYS. R. L. Edwards & H. Edwards. March 12th, 1917. (111,608.)
3,916. ELECTRIC BELLS. Sterling Telephone & Electric Co., F. G. Bell, and W. C. Davey. March 17th, 1917. (111,609.)
4,637. INTERRUPTER MECHANISM FOR ELECTRIC CIRCUITS. O. Mutto. March 30th, 1917. (111,414.)
5,246. TANKS FOR ELECTRICAL TRANSFORMERS. A. Schaanning & J. L. Thompson. April 13th, 1917. (111,621.)
5,301. CONTROL OF DYNAMO-ELECTRIC GENERATORS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) April 14th, 1917. (111,623.)
5,358. ELECTRICAL INSULATORS. G. V. Twiss & Bullers, Ltd. April 16th, 1917. (111,624.)
5,365. THERMAL ELECTRICAL RELAYS AND CIRCUIT CONTROLLERS. E. A. Graham & W. J. Rickets. April 16th, 1917. (111,420.)
5,644. LANTERNS OR CASINGS FOR INCANDESCENT ELECTRIC LAMPS. H. T. Wilkinson & Wardle Engineering Co. April 23rd, 1917. (111,629.)
6,374. STARTING APPARATUS FOR MOTOR-CAR ENGINES. Akt. Ges. Brown, Boveri, et Cie. May 29th, 1916. (106,820.)
9,108. ELECTRIC SIGNALLING DEVICES. J. Atherton. June 25th, 1917. (111,640.)
9,165. ELECTRO-PNEUMATIC BRAKE SYSTEM. W. V. Turner. December 6th, 1916. (111,439.)
9,204. ENGINE STARTER. V. Benedix. June 28th, 1917. (111,440.)
9,470. ELECTRIC SWITCHES. A. H. Midgley & C. A. Vandervell & Co. June 30th, 1917. (111,258.)
9,962. TELEPHONE EXCHANGE SYSTEM. Western Electric Co. (Western Electric Co., U.S.A.) July 10th, 1917. (111,261.)
10,129. ELECTRIC BATTERIES. Edison Swan Electric Co. & S. S. Bird. July 12th, 1917. (111,444.)
10,162. MINE SIGNALLING APPARATUS. J. Milligan. July 13th, 1917. (111,642.)
10,423. CORD GRIPS FOR ELECTRIC CONDUCTORS. C. G. M. Bennett. July 19th, 1917. (111,447.)
11,236. ELECTRIC MOTOR CONTROL SYSTEMS. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) August 3rd, 1917. (111,265.)
11,430. IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. W. O. Kennington. August 8th, 1917. (111,644.)
13,073. WIRELESS TELEGRAPHY AND TELEPHONY. Western Electric Co. (Western Electric Co., U.S.A.) September 12th, 1917. (Addition to 102,503.) (111,649.)
14,369. ELECTRIC MOTORS. H. L. Tanner. July 19th, 1917. (Divided application on 15,363/16.) (110,359.)
15,901. SHADEHOLDERS FOR ELECTRIC LAMPS. T. H. A. Brown. October 31st, 1917. (111,653.)

German Proposals for State Generation and Distribution.—A brochure on the "Form and Aims of a National Electricity Supply," written by Ludwig Aschoff, has recently been published in Berlin. The author outlines a far-reaching scheme of nationalisation for electricity generation and distribution, and considers it desirable that this fresh source of Imperial revenue should be tapped forthwith; "the immediate unification of public electricity supply is most desirable on political, social, and financial grounds." Both generation and distribution are embraced by the author's proposals, which are that generation should be taken over by the State and distribution by the provinces. Independent current supply in individual communities would be permitted by State concession in special cases only. Administration and operation would be on a broad and efficient commercial and scientific basis. A national Electricity Board would deal with matters concerning the State and provincial authorities and local Councils would be appointed to represent current consumers in each province. One of the primary duties of the National Board would be to regulate tariffs so as to secure a suitable net surplus and then to apportion the latter between the authorities concerned. Obviously, this scheme goes a good deal further than projects for the nationalisation of generating stations alone, as has been contemplated by several publicists.

Aschoff estimates that complete unification of public electricity supply in Prussia on the above lines, without raising the present prices for energy and without levying a tax, would yield about £8,000,000 net revenue, say 10 years hence, on an estimated ouput of 17,000 million units (compared with not quite £1,000,000 on 2,100 million units in 1913 and 1914-15). It is not possible at present to discuss the author's estimates in detail, but, as remarked by the *Bulletin* of the Association Suisse des Electriciens, it would have been more to the point to have compared receipts, expenses, net profit, and working conditions for, say, 1913 under (*a*) the present sub-divided system of generation and distribution; and (*b*) unified working such as is proposed by the author. A comparison of this sort would be more definite and more capable of discussion than one involving the probable state of electricity supply in the period 1926—1930.

Entertainment.—On December 27th, the Blackpool Tramways & Electricity Employés' Institute entertained the wives and families of employés on active service to a concert, tea, and Christmas tree in the Winter Gardens. About 300, principally children, were present.